POWER

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A TECHNICAL magazine must bring, from wherever they originate, the facts and ideas that will make its readers more useful to themselves. It must deliver these facts and ideas freed from the non-essentials that would waste the time of thousands of readers and hide from the busy man the things he should know.

THE job of choosing, concentrating and delivering goes on continuously, with the whole world for the editor's field of action. But there are places and times that focus engineering information and thus give opportunity for a special service to the reader. New York City, during the week of December 5, was a world center of fertile engineering ideas, and, by the same token, a unique editorial opportunity.

FROM all that happened in New York that week, *Power* has endeavored to select those things, and those things only, which have direct practical meaning for the power engineer. The aim in this mid-December publication is not to write engineering history, but to contribute to the future and the immediate tomorrow. To that end are reported the many sessions of the American Society of Mechanical Engineers, assembled for its annual meeting, the National Power Show, and the meeting of the American Society of Refrigerating Engineers. As a proper accompaniment to these reports, *Power* also presents in this number a review of new equipment items, most of which have appeared in its pages during the year. Others are descriptions of equipment shown for the first time at the National Power Show.

THESE are the tools of the next year's work. The ideas and facts presented by A.S.M.E. authors are for use by all engineers who can apply them in the interest of better design and operation. The equipment shown at the Power Show, and that reviewed in this number, are the facilities through which power ideas must be translated into progress.

IT IS significant that the stress of 1932 has in no way retarded the development of new equipment or the crystallization of power ideas. If anything, conditions have stimulated practical thought. This mid-December number should serve a real purpose in consolidating the power engineering gains of 1932.

A.S.M.E.
THOUGHTS, EVENTS AND PERSONALITIES

Two thousand engineers assembling for the annual meeting of the American Society of Mechanical Engineers, New York, Dec. 5-9, turn back to fundamentals as the best tool for solving the technical, business and human problems faced by the complex world of today

LOOKING back over the events of the A.S.M.E. annual meeting, one sees ample evidence that engineers are getting down to fundamentals; that they are re-examining the thousands of assumptions, theories and test methods in current use. The engineer has always been faced with the necessity of getting results, and has therefore been forced to make temporary use of theories, formulas and test methods of doubtful validity. Only his factors of safety have saved him from much trouble.

Back to Fundamentals

Their justified use for practical reasons has often led, by almost unnoticeable steps, to their unjustified acceptance as engineering "laws" and "perfected" engineering methods. But the engineers who presented papers at the annual meeting of the A.S.M.E. have displayed a refreshing skepticism regarding such matters. Paper after paper proceeded to re-analyze the old "laws" and the old assumptions, the first essential step in building a better foundation for future design and testing.

Specialists in mathematical mechanics, metallurgy, and strength of materials contributed much in two sessions on working stress. One of these was devoted entirely to metals at high temperatures, and the closely related problem of "creep." Authors in this symposium focussed attention on the fundamentals. They re-examined the basic definitions and tests of creep.

Fans have been tested for years, but too little attention has been given to such matters as pulsations in air flows and the influence of bends in inlet ducts. These fundamentals received timely attention.

Definite contributions to the problems of wet steam were made by C. C. Thomas, long known for his work in this field. The measurement of steam by nozzles in turbine testing brings up the old question of static pressure measurement, difficult and extremely important. This problem was re-analyzed with new data.

In the hydraulic session much attention was given to re-examination of the still tentative theories of turbine design. Working partly by theory and partly by rule of thumb, hydraulic engineers have made magnificent achievements. Further progress must involve a better knowledge of the fundamentals.

Papers attacked the problems of lubrication, tube stress, etc., from the angles of physics and chemistry. Committee meetings reported further research advances in the fields of steam tables and feed water.

The stress of the meeting, then, was clearly on the side of fundamentals, testing, basic theory—work that is essential to better design and operation. While papers dealing immediately with so-called practical subjects were in the minority, several of great value were presented. One dealt with the remarkable series of operating developments carried on with stokers at the Delray No. 3 Power House of the Detroit Edison Co. In the same classification must be placed the paper on "Performance of Modern Steam Generating Units," by C. F. Hirshfeld and G. U. Moran.

With this meeting, A. A. Potter, dean of engineering at Purdue University, assumes the presidency of the American Society of Mechanical Engineers. New officers inducted with him are Messrs. J. D. Cunningham, H. V. Coes and C. F. Hirshfeld as vice-presidents, all well known in American engineering circles and in the A.S.M.E.

Dean R. L. Sackett, of Pennsylvania State College, Prof. John Hunter of the University of Oregon, and Alex D. Bailey, superintendent of generation of the Commonwealth Edison Co., were inducted as managers for a three-year term. Pictures of the newly-elected officers will be found elsewhere in this number of *Power*.

Each year the A.S.M.E. presents, at its annual meeting, several addresses of broad general interest by outstanding readers. Three such lectures in this year's session were the Henry Robinson Towne lecture on Tuesday afternoon, presented by A. W. Robertson, chairman of the board of the Westinghouse Electric & Mfg. Co., the speech of the retiring president, Conrad N. Lauer, on Tuesday night, General Harbord's address at the annual dinner, and the Robert Henry Thurston lecture on Thursday night.

Mr. Robertson's speech was a challenge not only to the engineer, but to all thinking people, to apply scientific thought to human relations. He referred, at the start, to President Hoover's Committee on Industrial Rehabilitation, of which he is the chairman. "The Committee on Industrial Rehabilitation is attempting," he said, "to stimulate the world to purchase and install equipment, or other materials and supplies, necessary to improve, modernize or repair its properties."

On Tuesday evening Conrad N. Lauer delivered the presidential address and introduced the president-elect, A. A. Potter, dean of engineering at Purdue University. Honorary membership was conferred on Dr. John Ripley Freeman, past president of the Society, who died on October 6, of this year, some months after his election to honorary membership.

President Lauer's talk reviewed the history of the A.S.M.E. with reference to outstanding examples of service to mechanical engineering, to engineering in general and to the public welfare. He pointed to the many foundations, councils and committees through which the A.S.M.E. has co-operated with other engineering societies for the common good.

In closing Mr. Lauer referred to a recent development of great potential significance, the formation of the "Engineers' Council for Professional Development." This promises to have ultimately a far reaching effect on the personnel of the engineering profession and, in turn, upon a world which will be more and more shaped by engineering thought.

The new movement represented by the Engineers' Council for Professional Development is sponsored by the A.S.C.E., A.I.E.E., S.P.E.E., A.S.M.E., as well as the chemical and mining engineers, with endorsement of the National Council of State Boards of Engineering Examiners.

It recognizes the responsibility of the engineering profession for the dominantly technological character of present day civilization and stands as an acceptance of the challenge that engineers must assume broader leadership in construction thinking.

Building Better Engineers

The "Engineers' Council for Professional Development" has behind it a carefully developed philosophy.

Committees are being formed for the furtherance of the plan, which probably can not be better expressed than in the following words of Dr. C. F. Hirshfeld from the September *Mechanical Engineering:*

"First, to develop further means for the educational and vocational orientation of young men with respect to the responsibility and opportunities of engineers, in order that only those may seek entrance to the profession who have the high quality, aptitude and capacity which are required of its members;

"Second, to formulate criteria for colleges of engineering, which will insure to their graduates a sound educational background for practising the engineering profession;

"Third, to develop a program for the further personal and professional development of young engineering graduates and a program for those without formal scholastic training;

"Fourth, to develop methods whereby those engineers who have met suitable standards may receive corresponding professional recognition."

The annual dinner, to new members, supreme A.S.M.E. social event of the year, brought out more than 500 members and ladies. A dance followed the large dinner in the main ball room of the Hotel Astor.

Buying to Save

As principal speaker of the evening, General James G. Harbord, chairman of the board of the Radio Corporation of America, pointed to the work of The Robertson Committee on Industrial Rehabilitation as a vital factor in bringing back better business conditions.

Manufacturers throughout the country must proceed at once to modernize their plants where economically justified, to put themselves in readiness for the return of better days that are near at hand, General Harbord declared. His speech was notable for the avoidance of the emotional appeal. He urged, as other Robertson Committee proponents have urged, the support of this work strictly on a basis of self-interest. "Equipment can be purchased and installed today at costs much below normal," General Harbord pointed out. "Changes in equipment can best be made now while plants are not busy."

General Harbord did not suggest the installation of equipment to *increase* capacity. He merely said that common sense points to the installation of equipment that will save money *now,* at *present rates* of production.

Excursions scheduled for the annual meeting included trips through the Hell Gate generating station, the McGraw-Hill Publishing Co., and the steamships *Europa* and *Conte di Savoia;* also to the Hudson Avenue Generating Station, the Colgate-Palmolive-Peet Co., Seatrain Lines, Inc., and the East River Generating Station. Numerous special events were held for the entertainment of lady guests.

Two Thousand Engineers

In this year of stress nearly 2,000 engineers gathered in New York for the annual meeting. What greater recognition could be given to the value of contacts within the A.S.M.E., the world's largest professional engineering society. The pages that follow bring to *Power* readers everywhere a summary of those technical papers and discussions that hold the promise of better design and operation.

WET STEAM • • • HIGH-PRESSURE TESTS

DEBATED AT INDUSTRIAL POWER SESSION

Thomas experiments show unreliability of wet steam sampling, but point way to better separators. Purdue tests at critical pressures give rough confirmation of Keenan steam tables

To THE disappointment of some of those attending the meeting, the "Industrial Power" session, on Tuesday afternoon, contained no papers devoted specifically to industrial power equipment or problems. A similar comment could be made on the "Central Station Power" session of Thursday morning, where only one of the three papers presented was devoted primarily to the problems of central station plants. However, the fact that papers in both sessions contained information of value to all power-plant designers and operators made them of no less value to the workers in the specific branches.

While industrial plant engineers, in particular, could have profited greatly by papers discussing the special problems that confront them at this time, the lack of these papers did not mean that the meeting failed to give them information of very great value.

Sampling Wet Steam

For years power engineers have held in suspicion measurement of the moisture of wet steam. Sampling methods, in particular, have been suspected. That this lack of confidence is fully justified was shown by Carl C. Thomas, vice-president, Dwight P. Robinson & Co., Inc., a division of the United Engineers & Constructors, Inc., Mr. Thomas has long been known for his work in the field of steam sampling and quality measurements. He invented and patented the electric steam calorimeter. At the present time, in addition to his engineering and construction activities, he is an associate in engineering research at the California Institute of Technology.

Mr. Thomas conducted his recent experiment with an apparatus permitting observation, through quartz windows, illuminated, of the flowing steam. His results indicated that wet steam cannot be at all accurately sampled by sampling tubes, and that water should be separated as completely as possible and measured independently of quality determination. He found that perfectly transparent steam, to all appearances dry, can exist in the same conduit with a visible stream of water.

In the process of his experimental work Mr. Thomas developed a form of separator that makes possible the practically complete removal of water and the delivery of transparent steam to engines under test. From his work, Mr. Thomas was inclined to believe that steam which appears apparently perfectly transparent when strongly illuminated, is actually dry steam, and will be shown to be such by a suitable type of calorimeter placed inside of the pipe. Work is in progress to test the soundness of this belief.

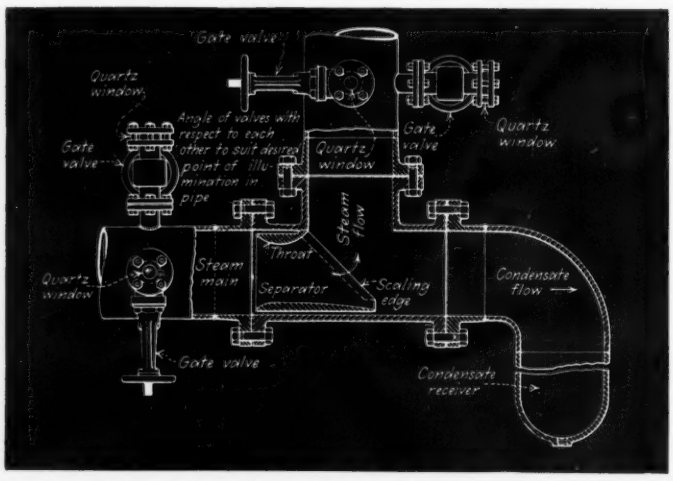


Fig. 2—One form of separator used by C. C. Thomas in steam sampling experiments

Wide interest in the paper of Mr. Thomas was demonstrated in the extended discussion. Its general trend indicated agreement that no dependable method of sampling wet steam is known or in sight.

C. F. Hirshfeld agreed that the standard A.S.M.E. sampling nozzle is entirely undependable. He complimented the author on the development of a very simple and apparently effective steam separator, and hoped that continuation of the research will eventually lead to more knowledge of the sampling of wet steam, which will greatly help the work of the Power Test Code committee.

Both Mr. Hirshfeld and Professor Christie stated that steam in the middle of a pipe may be dry while water flows on the outside. Professor Christie felt that the work of Professor Thomas may find application in the measurement of moisture in the later stages of steam turbines. One of the graduate students at Johns Hopkins University has been working on a similar problem for two years.

Practically all speakers agreed that no known methods of wet-steam sampling are reliable. Operators of superheaters and turbines, several pointed out, are greatly interested in moisture sampling and moisture elimination, since the impurities in the moisture cause much trouble with superheaters and turbine blades.

It was suggested that the experiments should be extended to cover other pressures and velocities, as these factors have much to do with the effectiveness of separators. One discussion pointed to Professor Thomas' experiments as confirmation of theories developed some time ago by work at the West Penn Power Co. Long experimentation with quality determinations of wet steam led them to the conclusion that calorimeter results are always unreliable, because the sampling method is unreliable.

Prof. G. B. Upton, of Cornell, referred to the "childlike simplicity" with which engineers have assumed that steam collected by a sampling tube shows the quality of steam in a pipe. The calorimeter, he agreed, is very precise, but the sampling is hopeless. The only help he could see for correct sampling is to devise a means whereby the water and steam in the pipe will be thoroughly mixed before the sample is drawn. Experiments at Cornell indicate, he said, that the actual moisture in the steam may be ten times that shown by the calorimeter sample, and suggested that the only remedy is complete removal of moisture by separators.

Prof. C. H. Berry, who has long been active in the Power Test Code work of the A.S.M.E., agreed that calorimeter measurements are totally unreliable and pointed out that the Turbine Code does not accept test results depending upon determinations of the quality of wet steam.

Another speaker agreed that sampling is unreliable, and that the best solution is to effect complete or practically complete separation of the water in the steam before it reaches the unit to be tested. J. G. Berger asked whether the experiments with wet steam could be extended to cover the removal of oil emulsion from exhaust steam.

Closing the discussion, Mr. Thomas presented additional evidence that transparent steam is actually dry. He indicated that much more experimental work is required.

High-Pressure Steam Data from Purdue

Recent experiments with the high-pressure boiler at Purdue University were described in the paper "High-Pressure Steam-Generator Research," prepared by H. A. Solberg, associate professor, G. A. Hawkins, instructor, and P. A. Willis, graduate student—all of Purdue University.

A "series" steam-generator unit, designed to operate on the Benson principle and evaporate water without boiling at pressures above the critical (3200 lb.) was installed in the Purdue Laboratory during 1931. It was expected that operation of this unit would give much practical information on the regulation of pressure and temperature under critical conditions and also make possible the extension and checking of existing data on the properties of steam. A paper presented at the annual meeting of December, 1931, described the operation of this generator at various pressures and temperatures well above the critical. The behavior of the unit on a swinging load under automatic electronic control was also described.

An important part of the work is the exploration of the field of fluid friction of steam at pressures up to 3,500 lb. and temperatures up to 830 deg. F. The results to date are insufficient to allow any definite statement. However it is expected that these studies of fluid friction will be completed within the next year.

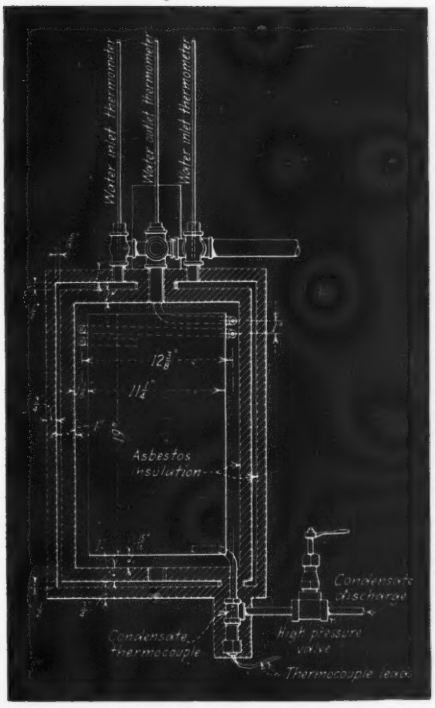


Fig. 1—Cross section (simplied) of colorimeter used at Purdue to determine enthalpy of steam at very high pressures.

Major attention since January, 1932, has been devoted to the preparation and use of a condensing calorimeter to determine the enthalpy of steam at very high pressures. The paper described this calorimeter and other test equipment and gave the test results.

Steam was condensed in a coil, surrounded by cooling water which had previously passed through the insulated calorimeter jacket. Heat leaks were determined by assuming the correctness of the Keenan table enthalpy values at lower pressures.

Check Keenan Values

The final reported enthalpy figures for 28 points between 1,900 lb. and 3,500 lb. checked the Keenan values, within the probable errors of the method of testing. The maximum variation shown was 6 B.t.u. per lb. and the average variation about 4 B.t.u.

In the absence of H. L. Solberg and G. A. Hawkins, the paper was presented by P. A. Willis. He gave additional results (not in the printed paper) for the range from 2,800 lb. to 3,400 lb. He pointed out that the work at Purdue does not pretend to the accuracy of steam-table research work conducted by physicists.

Discussing this paper, Prof. J. A. Goff, of the University of Illinois, said that while the experiments are an interesting confirmation of the Keenan tables, they should not be considered as a prime investigation of the properties of steam—that the experimental error was too great for this.

Prof. R. C. H. Heck of Rutgers compared the experimental error of nearly one-half of 1 per cent with the one part in 10,000 accuracy claimed for the work of Osborne & Keyes. He particularly expressed his feeling that the Purdue experiments alone should not be taken as adequate proof that the Keenan tables are more accurate than the Callender. Nevertheless, he felt that the results obtained are of some interest as a general confirmation. Dean Potter, of Purdue, in brief comment, stated that the tests were not intended as a primary investigation, but merely to give a rough direct check on the Keenan tables.

Mr. Ratsey said that future work at Purdue might well be directed to studies of creep, tube life, scale formation, heat transmission, etc., at high pressures and temperatures.

Mr. Ryan, of Stone & Webster, Boston, suggested that primary research be carried on at Purdue on fluid steam friction at high pressures and temperatures. The designer has great need for this data, he said.

Removal of Ash As Molten Slag

Report of the committee on the removal of ash as molten slag from powdered coal furnaces was made by K. M. Irwin. Work during 1932 is divided into two classes: first, amplification of work during 1931 on fluxing, and second, studies of samples of coal ash, slag and fly ash received from most of the stations operating slag-tap furnaces.

Requests for slag samples were sent to 16 stations, of which 15 promised co-operation, and samples have been received from 12. The study of these samples has not been completed, and no conclusions were given from the limited data now in hand. In general, the percentages of fluxes are greater in the slag than in the coal ash, but the differences are not large. The large range in flux content of the slag is represented by slags received from Glen Lyn and the Quindaro plants, the latter having almost five times the amount of flux in the slag as the Glen Lyn plant.

Two new laboratory furnaces were developed during the year for fluidity determinations. One uses gas which can be burned with either air or oxygen, the other is of the platinum resistance type in which the atmosphere surrounding the crucible can be controlled. Using these new laboratory facilities, studies are being made of the effect of the percentage of ferrous iron on the fusibility.

CENTRAL STATION ENGINEERS ANALYZE TUBE STRENGTH—FLOW NOZZLES

Nozzles to Measure Turbine Performance

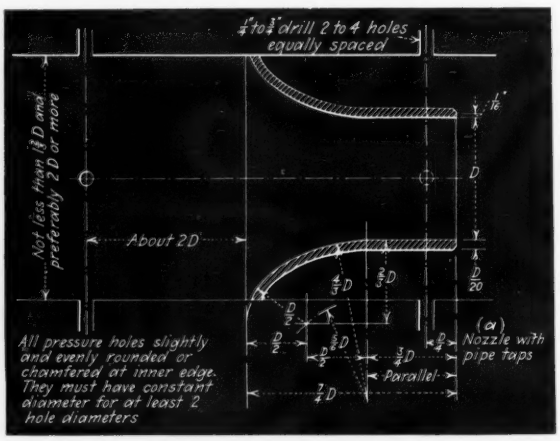
A SYSTEM of steam-flow measurement by means of a nozzle, for use in performance tests of jet-condensing, non-condensing, or extraction turbines when condensate measurements cannot be made, was described in a paper by S. A. Moss and W. W. Johnson. The paper gave in detail the precautions and refinements necessary in the test set-up, together with detailed dimension drawings of the nozzles used and the position at which the high- and low-pressure static pressures are to be taken. The system as outlined is on a laboratory basis to insure the accuracy necessary when steam turbine guarantees are involved.

In an appendix to the paper were reported the results of recent experience gained during tests made by the authors made with seven steam nozzles. Four of these were 4 in. by 2.2 in., a 6-in. by 1.2 in., an 8-in. by 3.67 in., and an 8-in. by 4.17 in. The coefficients of discharge determined by these tests were indicated in curves, which show very close agreement in the results obtained with the different sized nozzles.

Tests were made to determine the effect of various irregularities on the discharge coefficients of the nozzle. A dam which closed off half of one side of the pipe was placed in the pipe various distances from the nozzle. During these tests differential pressures were taken from three high-side static-pressure holes to three low-side static-pressure holes, and from an ordinary and specially designed impact tube with no vertical leg at the nozzle to the No. 4 low-side static hole. The open side of the dam was directly above the No. 4 low-side hole.

The dam caused no perceptible change in the coefficient obtained with the static differentials, until it was brought nearer than eight-pipe diameters. When the dam was brought quite near the nozzle the coefficients increased to values well over unity. This concentration of flow along one side of the pipe by the dam is considered to be as severe a condition as any ordinary unsymmetrical irregularity, such as an elbow or tee; hence the rule of 16 diameters following such irregularities.

A special test showed that a globe valve caused very little disturbance, even when nearly closed, hence it is to be treated as an ordinary unsymmetrical irregularity. A gate valve nearly closed, however, caused the two differentials of a pair 180 deg. apart to show as much as 5 per cent difference, even though followed by 20 diameters of straight pipe. A gate valve, followed by a bend, caused from 8 to 12 per cent variation between two differentials, and produced an unfavorable condition. With the same gate valve wide open, the variation was reduced to about 1.5 per cent. A gate valve partly closed is therefore to be avoided, unless very remote from the nozzle, or unless followed by special baffler or steam separator, or similar chamber.


¼ to ⅜ drill 2 to 4 holes equally spaced
Not less than ½D and preferably 2D or more
About 2D
All pressure holes slightly and evenly rounded or chamfered at inner edge. They must have constant diameter for at least 2 hole diameters
(a) Nozzle with pipe taps
Parallel

Dimensions of suggested standard nozzle

It was shown that a considerable amount of the differential pressure is recovered by reconversion of the jet velocity to static pressure in the pipe beyond the nozzle. Tests on the 6-in. by 3.12-in. nozzles showed practically 30 per cent recovery at a distance of 2 pipe diameters from the nozzle and 40 per cent recovery in 3.7 diameters. At 5.3 diameters recovery was about 40.5 per cent. A second appendix to the paper was devoted to formulas for steam flow.

Prof. J. H. Keenan, in discussing Mr. Moss's and Mr. Johnson's paper, presented the results of tests made at Stevens Institute of Technology, which seemed to indicate that a higher pressure would be measured by pipe tap connections after the nozzle than would be measured by pressure connections to the throat of the nozzle. This indicated results opposite to those obtained by Mr. Moss. In Mr. Keenan's test set-up, the pipe tap was made in a plane just following the end of the nozzle. Mr. Kennan felt that the discharge coefficient should be a function of Reynolds' number for the same nozzle or nozzle of dimensional similarity. He also showed curves which compared the discharge coefficient obtained at Stevens Institute, by Witte, of Germany, and Mr. Moss, when plotted against Reynolds' numbers. The Moss values for the discharge coefficient did not seem to agree with those obtained at Stevens Institute and by Witte.

R. E. Sprenkle reported results of tests similar to those made by Mr. Keenan, also designed to compare the throat tap pressures with the pressures obtained by pipe taps. In this set-up, however, the pipe tap connections were made in the same plane as the throat tap connections. The results obtained were the same as those indicated by Mr. Moss, and the opposite of those indicated by Mr. Keenan's test. That is, the pressure at the pipe tap connection was found to be less than the pressure found at the throat tap. He found that the throat tap connections were more sensitive to manufacturing imperfections than were the pipe tap connections.

Discussion by Mr. Tucker related test readings made on a flow nozzle installed in the discharge line from the condensate pump during acceptance tests on the 160,000-kw. turbine at the Brooklyn Edison Co. The discharge coefficients obtained from these tests, plotted against Reynolds' numbers, seemed to show consistent results.

Other discussions indicated the reluctance of utility operators, who have installed extremely large turbines, to stand the expense of putting in the extensive weigh tanks necessary to run acceptance tests on these large machines. Turbine manufacturers expressed a willingness to accept tests made on nozzle set-ups as given by Mr. Moss.

In closing the discussion Mr. Moss suggested that the short length of the throat tap, used in the tests by Mr. Kennan and also those by Mr. Sprenkle, might account for some of the inconsistency and presented curves that

showed the error possible when using throat taps of too short length. He expressed the belief that discharge coefficients from flow nozzles cannot be plotted against Reynolds' numbers.

Stresses in Boiler Tubes

ATTENTION has been called in recent years to the high stresses set up in the tubes of steam boilers due to high rates of heat transfer from burning fuel and products of combustion to water boiling within the tubes. To get a more accurate picture of the stresses in thick boiler tubes subjected to high rates of heat transfer, an investigation made of the subject was reported in a paper by William L. De Baufre.

The stresses were investigated for non-uniform heat absorption around the tube circumference, as well as for uniform rate of heat absorption. The difference in temperature between the inside and outside surfaces of the tube was shown to vary from about 10 deg. at low heat rates and low steam pressures to as high as 123.5 deg. at high heat absorption rates and high pressures.

The investigation has shown that where the stresses produced by heat transfer and internal fluid pressure exceed the elastic limit of the material near the inner and outer surfaces of the tube wall, the calculated stresses based on perfect elasticity are greatly reduced by plastic flow, but residual stresses are thereby set up when heat transfer ceases and the internal fluid pressure is reduced to zero. Every time a boiler goes into and out of operation, a stress cycle from tension to compression occurs of considerable stress range. This stress range is greatest for the circumferential stress at the inner surface of the tube wall when the tube is heated uniformly. When heated non-uniformly, the actual stress range may exceed the circumferential stress range under certain abnormal conditions. It is shown by comparison with experimental data, however, that a boiler tube will not fail within any reasonable period of time by fatigue from these repeated stress reversals.

Before a boiler tube can fail by bursting, all portions of the tube wall may be stressed to a point where more or less rapid creep will occur. The investigation shows that before this can take place all heat transfer stresses will be entirely neutralized by creep. Failure of the tube then occurs by the stresses due to internal pressure only. A measure of the safety of the tube is the ratio of the stress which will cause creep under the mean operating temperature of the tube wall to the mean stress caused by internal fluid pressure.

Increase in tube safety is secured by using thicker rather than thinner tubes than called for by the A.S.M.E. Boiler Code. An increase in safety may also be obtained by using material which will not creep until a higher stress is reached, such as a medium-carbon steel in place of mild-carbon steel. Even with mild-carbon steel subjected to a very high rate of heat absorption, failure can occur only when the coefficient of heat transfer from the inner surface of the tube wall to the water-steam mixture within the tube is reduced to an abnormally low value. Boiler-tube failures therefore occur by reason of poor circulation of the water-steam mixture within the tube, by accumulation of scale on the inner surface of the tube wall, by corrosion, or by defective material, rather than by any stresses due to unequal expansion within the tube wall caused by high rate of heat absorption.

In discussing Professor De Baufre's paper, Mr. Orrok expressed the belief that the margin of safe tube temperature would be less with a thick tube than with a thinner tube. He agreed that a thicker tube would be immune to fatigue failure, due to one shutdown and starting up of a boiler per day, but pointed out that there were parts of a boiler where similar stress cycles were occuring all the time, and that these points would be subject to fatigue. He stated that the outside wall temperature was of great importance, and should be kept with reasonable limits. In connection with the use of high-carbon and alloy steels for boiler tubes, he pointed out that the tube thickness would be affected by the change in the heat conductivity of the higher strength materials, the conductivity decreasing in the order of 48 to 16 for the high-carbon and alloy steels.

Dr. Jacobus pointed out that tube failures almost invariably were due to deposits on the inside of the tube. He also presented figures comparing the tube thickness allowed by the new German boiler code. This code permits lesser wall thicknesses than does the A.S.M.E. Code, but at the same time permits steels of higher tensile strength. He also suggested that boiler designers would be greatly interested in the author extending his figures to heat transmission rates of 125,000 to 150,000 B.t.u. per hour.

C. F. Hirshfeld suggested that much may be learned about the creep of metals at high temperatures by studying the action of lead under normal temperatures. He disclosed that tests on lead at very low temperatures had indicated that this material would produce a stress strain curve similar to steels at normal temperature. In closing the paper, Professor De Baufre pointed out that the creep occurs on the inside of the tube. He also said that he had made up curves which attempted to correlate heat conductivity with the varying composition of steel, and it was his opinion that heat conductivity did not vary with high- and low-carbon steel as much as Mr. Orrok had indicated.

Performance of Steam-Generating Units

A STUDY of the performance of modern steam generating units was started by C. F. Hirshfeld and G. U. Moran in July, 1928, with the collection of daily operating data from 186 boiler units in 50 plants throughout the United States. The analysis of one year's records was presented in a paper in 1929, and again, in 1931, another progress report was made. The present and final paper represents an investigation of 250 units in 61 states, covering the three-year period between July 1, 1928, and July 1, 1931. In the paper are tabulated the data obtained concerning the operating performance of these boiler units.

In general, the results of the 3-year study bear out the relationship indicated by the 1929 report, the differences being only those of degree. There still seems to be no appreciable difference in reliability between pulverized fuel firing and stoker firing. The small margin in favor of the former method is very small when compared with the range between the high and low individual values in both groups. There is some indication that the storage pulverized coal systems have the advantage in reliability over the unit system. Likewise, in regard to stokers, traveling grates seem to have a slightly higher availability factor than underfeed stokers. In both of these cases the difference between the high and low limits in each case is far greater than the difference between the averages, and do not justify placing too great weight on the results.

The decrease in availability due to preheat is marked, being from 0.018 to 0.063. This difference is not as great as indicated in the 1929 report, which would seem to indicate that the use of preheat is now better understood, or that the degree of preheat has been reduced.

Two stations experienced difficulty in maintaining correct alignment of soot-blower elements due to warping. The result was the cutting of the boiler and superheater tubes to such an extent that tube replacements were abnormal.

Only one station reported outages other than normal in the oil-and-gas-fired group.

Stokers seem to have had their greatest difficulties with preheated air and the wrong type of coal. Plain refractory walls were the cause of considerable cripple time in all classes. Another large cause of outage was that due to cleaning dust-clogged air preheaters and excess slag accumulations from the boiler tubes.

The authors state that it is their opinion that modern steam generating equipment may be relied upon for use from 82 to 86 per cent of the time, and that there is every indication that this state of affairs will improve somewhat in future.

SUPERCHARGING

CENTER OF LIVELY OIL & GAS POWER SESSION

ONLY one paper, that on "Diesels for Small Boats," by A. B. Newell, was presented at the Oil & Gas Power Session, Dec. 7, in addition to the annual report of the Oil & Gas Power Division. The Progress Report itself, prepared by P. H. Schweitzer, professor of engineering research at Pennsylvania State College, aroused considerable discussion.

Progress Report

ACCORDING to the report, during the year modern high-speed engines have been found to react to certain fuels by knocking. The suitability of a diesel oil is largely determined by a previously undetermined fuel characteristic, the ignitibility. The oil which ignites readily after a short ignition lag is the desirable fuel for diesel engines. Customary diesel fuel-oil specifications never contained such an item as ignitibility; therefore they are now considered inadequate. The A.S.M.E. Committee for Diesel Fuel-Oil Sepecifications, in cooperation with the S.A.E. and the A.S.T.M. committees, is giving special attention to this phase of the fuel problem. The insight gained by recent investigations already has enabled several oil companies to bring distinctly superior diesel oils to the market. Their high price prevents their general use as yet.

High-speed engines are not the only ones concerned with the fuel problem. An important factor in retarding development of the large marine diesel engine here is the fuel price situation, which in the United States shows a differential of over 100 per cent in the prices of boiler fuel and diesel fuel in favor of the former. Future development of the large diesel engine, whether stationary or marine, in this country appears to be contingent upon active development of methods of utilizing boiler oil for diesel engines; this is now in progress.

The field of the oil engine has become so diversified and includes so many types that each has progressed more or less along its own line. General tendencies in design that were noted in the report have been the almost complete displacement of air injection by mechanical injection, further increase of speed and reduction of weight for given piston displacement, a slight shift in trend in favor of the single-acting, two-stroke cycle, preference for enclosed engines, increased use of alloy steels, and growing dependence upon specialty manufacturers for such parts as injection pumps and nozzles.

The over-all cost of a complete diesel-generating station of moderate capacity, including land and building, may now be safely estimated at $85 per kw. installed, as compared with $150 per kw. only a few years ago. The reduction is greater than the general drop in price of machinery during the same period. Adoption of solid injection, use of trunk pistons of progressively larger diameters, and stepping up of rotative speed are largely responsible.

In regard to construction, the welded steel frame constitutes the most noteworthy innovation that has originated in the last year or so. Results obtained in the way of weight reduction are little short of miraculous. The engines of the new German naval vessel *Bremse* weigh only 14 lb. per b.hp., while both M. A. N. and Sulzer are developing engines of 2,000 b.hp. per cyl. at 265 r.p.m. and weighing around 22 lb. per b.hp. (Several companies are prepared to build 40,000-hp. engines.)

Engines of high power are now built with one-tenth the weight per b.hp. that was considered normal only a few years ago. Some aircraft engines, developing 1,200 hp. at 1,000 r.p.m., weigh only 4.4 lb. per hp.

Another important development is the process of "hydrogen brazing" of engine parts, primarily cylinder heads, introduced by A. E. G. Instead of a single casting several simple forgings are made and united effectively by the the new method.

Dope for diesel fuels is an imminent possibility. (It is understood unofficially that the DuPont Company will "dope" diesel fuels for anti-knock characteristics. The dope, believed to be ethyl nitrate, cannot be shipped to the consumer for his own use because it is, paradoxically, a liquid explosive, yet is perfectly safe after addition to the fuel.) The National Advisory Committee for Aeronautics has discovered some new data on fuel vaporization. Contrary to prevalent opinion, Rothrock found that the vaporization of fuel is extremely fast and practically complete before ignition occurs in the engine. Pennsylvania State College has completed its investigation on spray dispersion and the report is available in book form. Liquid turbulence was found to be the primary, and air friction the contributory cause for spray dispersion.

Massachusetts Institute of Technology has obtained interesting results with a fuel-injection, spark-ignition engine.

Two-cycle gas engines have recently been reintroduced, and have much improved fuel economy. M. A. N. is applying its reverse scavenging principle to the gas engine, obtaining four-cycle economy with much reduced first cost. Clark Brothers Company has developed the "injection gas engine," in which the gas is introduced by a pump after the exhaust ports are covered by the piston, and thermal efficiencies exceeding those of the four-cycle engines are obtained.

Discussion of both the report and the paper on small-boat diesels was unusually spirited and brought up a number of rebuttals and surrebuttals between advocates of supercharging, air vs. mechanical injection and other controversial topics until Chairman R. D. White, Captain, U. S. Navy and Supervisor of the Harbor of New York, was forced to call for order. High points in the discussion included the fact that the world's largest diesel station is not, as generally believed and as reported in the Progress Report, that at Vernon, Calif., but is a 36,500-hp. station at Shanghai, China, now adding 13,500 hp. of Sulzer engines to bring its total to 50,000 hp.; that new automotive diesels under development run at speeds up to 3,000 r.p.m. and will eventually run at speeds of 4,000 and 4,500; that instead of the common belief that engines will be simplified as development advances they will in all probability be made more complicated just as the automomible engine was. Several discussers presented the point of view that the small diesel particularly should be simplified so that the casual operator, such as those who usually run such small plants, might have fewer difficulties. David Dasso, of Sulzer Brothers, was of the opinion that greater complication might, in effect, result in greater efficiency.

AIR VS. MECHANICAL INJECTION

Sulzer has also gone back to the piston-type of scavenging pump because it appears more dependable and is not necessarily more expensive, and in some cases has actually shifted back to air injection. These particular cases are those where fuels of particularly low grade, such as boiler fuel, are encountered, where mechanical injection engines will not work properly over long periods even with preheated fuel

(Continued on page 345)

FLOW MEASUREMENTS AND DESIGN DOMINATE HYDRAULIC SESSION

Theories of pump and hydraulic turbine design advanced, a description of the world's largest outdoor hydraulic laboratory (where flows of 141 sec.-ft. and volumetric measurements up to 52,900 cu.ft. are provided) and a study of flow of fluids in pipes featured the Hydraulic Division meetings

Prof. Wilhelm Spannhake

Pump and Turbine Design Theories Extended

TURBINE and pump designs have developed extensively during the last fifteen years and both are benefiting by the achievements of modern hydrodynamics. Although the ideas upon which present theoretical and experimental methods are based are used successfully in the design of both high- and low-head hydraulic machinery, it is in the low-head designs where these are the most important. Furthermore, it is true that practical ability backed by engineering judgment must still precede strict mathematical rules and formulas, because the necessary fundamental knowledge of many hydraulic phenomena is not yet available for the complete analysis of design problems.

There are still many unsolved problems, in the field of turbines in general but these appear to be most critical for low-head machines operating at high specific speeds. In a paper, "Problems of Modern Pump and Turbine Design," Prof. Wilhelm Spannhake, visiting professor of hydraulics at the Massachusetts Institute of Technology, discussed these questions, pointed out the essence of the problems and showed in which directions the answers to many of them later may possibly be found.

It is evident from this paper that high turbine and pump efficiency is dependent to a very large extent upon several details of design which, if not thoroughly understood, may result in poor performance where otherwise high efficiency could be obtained. Among these details are the ratio of the change in tangential component of the flow to the speed of the runner, the ratio of the tangential component at the exit of a turbine or entrance of a pump to this same speed of runner, and the ratio between the square of the axial velocity at discharge of a turbine or entrance of a pump and the velocity corresponding to the head. These three factors influence the proportions of the velocity diagram.

The speaker first gave a general review of the present status of design principles applied equally to centrifugal pumps and hydraulic turbines, and then developed step by step the fundamental ideas underlying the theoretical behavior of a runner having an infinitely large number of thin blades which guide the fluid perfectly. The resemblance between the blading ordinarily used and the wing of an airplane has led to analysis on the basis that each blade acts as an airfoil. Attention was called to the many limitations of this theory, and a new beginning was suggested, taking as a starting point the theoretically perfect runner. By decreasing the number of blades first from infinity to a finite but very large number, he analyzed the forces and influences that are at work. Although Professor Spannhake did not claim to have arrived at a final solution, he demonstrated the play of one effect upon another, and suggested that further experimentation should assist in making proper allowances for the uncertainties not subject to strict analysis which become more and more important as the number of blades is reduced.

The final section of the proper dealt with the best conditions for the design of high-speed runners. The influence of the principal figures of layout, upon which both efficiency and cavitation are dependent, were discussed and curves for efficiency and cavitation coefficient were given for three different specific speeds. These curves demonstrated clearly that narrow blades are more conducive to efficiency but are less advantageous from the point of view of cavitation. Consequently, it is necessary to strike a compromise between efficiency and cavitation. Furthermore, for higher specific speeds the design is exceedingly sensitive to having the proper conditions in every respect. Therefore, to take advantage of the attractive possibilities in the utilization of higher specific speeds, it is necessary to seek a better knowledge of the problem and to solve one by one the many unknown factors that have been enumerated in the paper.

Professor Spannhake feels that both theories, in spite of their defects, can be used to advantage as experimental knowledge is progressively increased, and demonstrated that mathematics will throw light on a number of vital problems dealing particularly with efficiency and cavitation. He suggested for consideration a special type of profile, and expressed the hope that by combining the laboratory with theory it should be possible to realize improvements in existing equipment, and finally build up a strict method for pump and turbine design meeting properly and satisfactorily all requirements for high specific speed and small number of blades.

DISCUSSION

From the discussion on this paper it was evident that although it can't be said that Prof. Spannhake came to a final conclusion in the way of prescribing how turbines should be designed, nevertheless he has done a monumental piece of work. He presented for the first time in the English language the influence of various factors upon cavitation and efficiency, and so connected the characteristics of the velocity diagram to the performance of the turbine.

Largest Outdoor Hydraulic Laboratory

THE world's largest open-air hydraulic experimental station was described in a paper, "Research Institute for Hydraulic Engineering and Water Power," by Hunter Rouse. This laboratory is located at Obernach, near Munich, Germany, and is under the direction of the Research Institute for Hydraulic and Water Power.

The initial major experiments at the laboratory was to make simultaneous measurements of flow through the concrete-lined canal by means of the four leading European and American methods. The sharp-crested suppressed weir, the Allen salt-velocity, the chemical or titration, and the current-meter methods of measuring discharge were tested for five different rates of flow, all based upon the volumetric record taken at the measuring basin several times during each run. Of the four methods, used, the titration method was said to be the most consistently accurate.

For the purpose of comparing the leading European and American methods of measurement of penstock discharge for the determination of turbine efficiency a series of tests was made at the Walchensee power plant by several English and German firms in collaboration with the Research Institute. The tests were made on an 18,000-hp. pelton-type unit with a penstock 600 ft. long and operating under a 600-ft head.

Tests were made with the salt-velocity, pitot-tube, current-meter and Gibson method of water measurement. Results of these experiments lead the experimenters to the conclusion that for the conditions prevailing at the Walchensee plant, the current meters gave the most dependable results.

DISCUSSION

In the discussion of this paper the conclusions drawn by Mr. Hunter from the test data and the test procedure were very seriously criticized by several speakers. An exceedingly constructive discussion was presented by Marcus J. Mousson, hydraulic engineer, Safe Harbor Water Power Corporation. Mr. Mousson said that:

"The conclusions drawn from Walchensee tests by the engineers conducting the tests, need more careful analysis to avoid being misleading. Unfortunately, some European engineers have concluded from the results that the Allen salt-velocity method, the Gibson and pitot-tube methods would be permanently abandoned in the near future. However, it must be said that in America we see no weakening of faith in these methods where conditions are suitable, but rather a development of current-meter application for conditions where satisfactory tests by means of other methods do not appear to be possible. For instance, at Safe Harbor the current-meter method was chosen, not because of prejudice against any other method but because it was believed that the physical layout of the water passage is extremely favorable to the method finally adopted.

"There are enough data at hand to substantiate the fact that American and European methods give identical as well as reliable results, when the layout is favorable to the same degree for the various methods. Much harm may be done to any method, whether salt-velocity, Gibson, current-meter or salt-titration, when applied for unsuitable physical conditions, or if the test personnel is lacking in necessary familiarity with the methods and the difficulties which may be encountered.

E. B. Strowger, hydraulic engineer, Buffalo, Niagara & Eastern Power Corporation, in his discussion called attention to tests made in Europe comparing the Gibson and other methods of water measurement. At the Brunnenhule testing plant of J. M. Voith, in tests comparing the Gibson method with wier measurements, the average divergence between the two methods was 0.16 per cent. Tests made at the Eitting plant showed a variation of only 0.01 per cent between current meters and the Gibson method. Comparisons made in Italy, in one case using weighing tanks and in another current meters, showed agreement with the Gibson method as close as those previously given.

In 1931 Mr. Strowger made an independent Gibson test of two francis type turbines operating under a head of 200 ft. that had been tested previously by the Allen salt-velocity method. The results obtained by the two methods were practically identical. All the results referred to by Mr. Strowger would seem to be within the limits of possible precision in tests of this kind; in any event, they are well within the limits required for practical purposes.

Prof C. M. Allen of the Worcester Polytechnic Institute was of the opinion that if the salt-velocity method of measuring the flow of water was applied as one might assume from the paper, the tests were a long way from what they were supposed to be. Apparently the personnel of the new laboratory was not familiar with the development made in the salt-velocity method since 1923 and consequently did not use accepted practice. That their first tests showed results within 1.2 per cent of the volumetric values, in Professor Allen's opinion, speaks well for the salt-velocity method of water measurement in the hands of inexperienced men.

Attention was called to the lack of proper instructions to those responsible for using the salt-velocity method in the Walchensee plant tests and that inadequate apparatus was used and was improperly applied. Only one pop valve was used, when standard practice is to install two to four such valves. Four electrode stations were used, where standard practice would have used only one. The electrodes were of improper design and improperly located. Direct current was applied where alternating current only is recommended. Because of this and the small size of the electrodes the salt curves from the Walchensee instrument were very difficult to compute accurately.

Fluid Flow in Pipes Investigated

NO SCIENTIFIC basis for analyzing experimental data on the flow of fluids was available until Osborne Reynolds developed equations based upon pipe dimensions and fluid characteristics in 1873. In view of the fact that only a small part of the experimental work previous to that of Stanton and Pannell, in 1914, has been reduced to Reynolds' dimensional basis, Emory Kemler undertook an investigation to obtain a more complete knowledge of flow problems. The results of this work he presented in a paper, "A Study of the Data on the Flow of Fluids in Pipes." The paper consists very largely of curve sheets of flow in a wide variety of pipes, the curves being plotted for Reynolds numbers R and pipe-friction factor F. These curves are for new and for used pipes and pipes that have had their insides artificially roughened.

Memorial Proposed for John R. Freeman

BLAKE R. Van Leer, after presenting a brief summary of the life work of the late John R. Freeman, proposed that a movement be started to create a memorial to him. Mr. Van Leer said in part:

"Mr. Freeman would not desire that we grieve over his absence. He would want us to be working diligently as he worked to help in solving the problems of our times. Hence, I have the honor at this time to propose, in behalf of the John R. Freeman Scholars, that the A.S.M.E., A.S.C.E. and Boston Society of Civil Engineers engage in a joint undertaking as a memorial to the founder of these scholarships, Mr. John R. Freeman. I therefore move that this Division present such a petition to the A.S.M.E. Council with the request that that body form a committee to confer with the other two societies to the end that such an undertaking may be started." The motion was carried unanimously by the meeting.

DELRAY STOKERS . . . FUEL PROGRESS

Changes to Delray stokers raise over-all yearly efficiency from 82.3 to 85.4 per cent — Fuel report shows growing competition between coal oil and gas — Method of measuring metal temperatures of boiler tubes outlined

Stoker Combustion Rates Increased

In 1929 the Detroit Edison Co. installed in its Delray powerhouse No. 3 five single-ended stokers, which at that time were the largest of their type. During the three years of operating experience with these stokers, various changes have been made as a result of development work at the plant. The nature of these changes, the reasons for them, and the results obtained, were discussed in a paper by P. W. Thompson and Fred J. Chatel.

The underfeed stokers installed at the plant are 15 retorts wide and 57 tuyeres long. They were rated to burn 34,000 lb. of coal per hour, with a projected grate area of 611 sq.ft. when supplied with preheated air at 360 deg. F. The stokers are driven through cog belts from 35-hp. d.c. motors having a speed adjustment of 500 to 2,000 r.p.m. Each retort of the stoker was equipped with six coal pushers and a movable extension grate.

Little trouble has been experienced with clinkers in the fuel bed when proper pusher strokes have been maintained. However, improvements have been made to cope with sheets of slag formed on the side-walls and clinkers at the bottom of the tuyere stack, as well as on the extension grate. Special refractories to deflect the slag formed at high ratings have been placed in the sidewalls above the half tuyeres to prevent the formation of slag sheets. The slag runs down over the deflectors, and is continuously carried away with the burning coal, instead of being built up into large sheets which eventually break loose and foul the fuel bed at the end retort. The bottom square-ended pushers were replaced with longer beveled pushers, which are more effective in cleaning the clinkers from the coal-plate. extension and grates.

With the original arrangement of six square-nosed adjustable-stroke pushers per retort, the coal was not sufficiently packed at the stoker front and in the retort, and excessive agitation caused smoke. As a result of improper packing, combustion often took place deep in the retort. This caused the burning of iron and the formation of large clinkers on the bottom plates and extension grates. It became evident that fewer pushers would deepen the retort, produce better coal packing and enable the operator to maintain a uniform fuel bed with less agitation. To obtain a comparison, one stoker was arranged with five pushers and another with four pushers per retort. The four-pusher-per-retort arrangement showed a decided improvement over the other two arrangements. Poorer grades of coal could be handled efficiently. There was less tendency to smoke, and improved construction resulted in a reduction of coal siftings from approximately one-half per cent to less than one-tenth per cent. The power consumption with the four-pusher arrangement was 30 per cent less at a steaming rate of 200,000 lb. per hour than with the original design.

After the first few months of operation it was decided to install larger power-boxes and pusher shearing pins. The forces transmitted through the stoker mechanism had been underestimated, and the change was made so that the pins would withstand the normal shearing forces and still give protection to the stoker.

Automatic Air Control

The zoned automatic air control developed for Delray provides regulation of the air to four zones of each tuyere section. Air is supplied from the plenum chamber through an individual control box and air duct to each of the four sections of each tuyere stack, making 56 such boxes per stoker. Each control box is equipped with an orifice, a balanced cylindrical damper, and a motor mechanism which regulates the damper opening by power supplied from the drop in pressure across the orifice. The pressure differential across the orifice, a measurement of the air-flow volume, is maintained practically constant throughout the operating range of the boiler by varying the orifice area. With the controls in operation, and a fuel bed of the desired thickness, the dampers remain balanced. Should a portion of the fuel bed become heavier, or thinner, the controls under this particular section will operate to give an increase or decrease of the air quantity.

It was determined that approximately 50 per cent of the total air for combustion passes through the control unit, and of this quantity the dampers have a controlling effect up to 20 per cent. The pressure loss through the dampers amounts approximately to 1 in. of water, which corresponds to a power input of 20 kw. to the forced-draft fan.

With these changes it has been possible, for intervals of approximately 10 hours, to burn as high as 45,000 lb. of coal per hour. Continuous operation at more than 41,000 lb. of coal per hour is limited by the accumulation of ash on the slag screen and in a superheater pass. The over-all stoker and boiler, economizer and preheater efficiency increased from a yearly value of 82.3 per cent in 1930 to 85.4 per cent in 1931.

The paper also contains a description of the air control installation at the Beacon Street heating plant, together with operating results. The information contained in this portion of the paper was contained in an article published in the December number of *Power*.

Mr. Houghton, of the Brooklyn Edison Co., opened discussion of Mr. Thompson's paper by indicating an opposite point of view with respect to the method of operating underfeed stokers. Mr. Houghton expressed his belief that the changes made in the Detroit stokers to deepen the retort and cause the coal to be more tightly packed were not a move in the right direction. It has been his experience that thin coal is best for normal operation, and that such a coal bed can be brought to high ratings quicker than a heavier fire. He recommends that combustion air be drawn through the fuel bed by maintaining a high over-fire draft, instead of being forced through by under-fire pressure. The zero pressure should be in the fuel bed instead of above it. He claims that this method of firing both lowers stoker maintenance and auxiliary power needs.

The results of operation of an experimental stoker in the Richmond Station were described. This installation was made for the purpose of determining the possibility of burning cheaper coals, such as are commonly used in pulverized fuel installations. It was found that the cheaper coal could be burned, and combustion rates of 72 lb. per square foot of grate area were obtained. Features of the experimental stoker involved the use of Carborundum plates in the extension grate, the use of larger clinker grinders, zoned air control, deeper ram box, improved pusher design, the introduction of air at the bridgewall, and slag drips on the side and rear walls.

Mr. Moultrop stated that proper air control would be the salvation of stoker development, and cautioned against trying to install stokers of record-breaking size. He expressed the belief that the operating methods advanced by Mr. Houghton were worthy of further study and investigation.

Measurement of Metal Temperatures

DESIGN of heat-transfer equipment frequently involves use of very high metal temperatures. In measuring the temperature of metal walls under operating conditions, thermocouple wires are attached to the outside wall. The wires pass through a high-temperature zone, as in the case of hot flue gases, and are heated above the temperature of the wall. This heat flows through the wires to the thermocouple junction and introduces errors, the magnitude of which was investigated and reported in a paper by Arthur Williams. The tests were made in a two-pass gas-fired test superheater, and several methods of measuring wall temperatures were compared.

Constantan-steel thermocouples were used to measure the inside and outside wall temperatures, the leads being brought out through the inside of the pipe. Other sets of outside wall temperatures were taken by chromel-alumel thermocouples peened into the outside wall and by a constantan plug screwed into the pipe. In these latter temperature measurements the leads were led along the outside of the pipe for a distance of about 2 in. and wrapped around the pipe for about half the circumference. The wires were insulated electrically from the pipe by a sheet of mica which, however, is not a thermal insulator.

From the results of the temperature measurements made, the following conclusions were drawn: First, that it is important to use the minimum diameter thermocouple wire consistent with reasonable life. Second, the wire should be applied so that for a distance from the hot junction of at least 2 in. the wires are insulated electrically from but have good thermal contact with the pipe wall. It is possible to measure the outside wall temperature with reasonable accuracy, applying the thermocouple wires to the outside of the pipe. The maximum error recorded during the test with this method was approximately 2 per cent.

Progress Report of the Fuels Division

THE progress report of the fuels division is divided into a number of sections, among which are those relating to natural fuel production, steam generation, and smoke abatement.

The year has been characterized by a general slackening of technical progress in the fuel industry, a condition which has not been unexpected. Of particular importance has been the increased competition between fuels, particularly between coal, oil and natural gas, and the determination of operating engineers to use the cheapest fuel available at all times, whether it be one of the three mentioned or some fuel available locally, as, for example, petroleum coke or acid sludge. Fluctuating prices of the various fuels, relative to one another has created a strong demand for combination furnace that will handle coal, oil or gas with few or no changes necessary when changing from one fuel to another.

In the first eight months of 1932 the production of bituminous coal decreased 22.1 per cent from the production of 1931 in the same period. During the first seven months of the year the production of crude oil dropped only 7 per cent. Although statistics indicate a drop in natural gas sales of about 8 per cent, natural gas is, nevertheless, becoming so widespread in its distribution that there is scarcely a section of the country that has not been influenced by either its advent or its approach.

Atmospheric pollution from dust and sulphur fumes is still a serious problem, and extensive research, hampered somewhat by the economic situation, is being carried on for its elimination. There is a rather growing conviction that the preparation of coal is a more fertile field for the solution of the sulphur problem than is scrubbing the stack gases. A serious obstacle to any smoke study is the unsatisfactory state of test methods and instruments.

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FAN TESTING AND PERFORMANCE AS INFLUENCED BY INLET DUCT

Effect of Pulsation on Fan Test Procedure

CERTAIN inconsistencies which have appeared in the development work of the fan industry appear to indicate that something is wrong with the accepted method of testing. These inconsistencies have come up in cases where, according to the test data collected, the general law of conservation of energy, and Bernoulli's law in particular, seem to have been violated. In addition, recent tests on propeller fans with two blades have shown unreasonably high efficiencies. A third type of inconsistency noted has been the apparently unexplainable agreements and differences encountered in attempting to check pitot-tube traverse determinations with flow-nozzle volumes. In many cases agreement between these two methods of measurement has occurred with great exactness; in other cases, even when the extenuation of poor distribution did not apply, differences of a magnitude beyond any reasonable test accuracy have appeared.

Concluding that these various inconsistencies might be explained by air pulsations, H. F. Hagen set out to determine the extent of pulsations present when testing the ordinary centrifugal fan, and the probable effect of these upon the accuracy of volume measurement with pitot-tube traverse.

Pulsations introduce an error, because the air measurement wanted is the average of the first power of the air velocity, whereas that obtained with a pitot tube is the average of the instantaneous squares. The error resulting from this will be seen from the example, in which an ideal square wave is considered, which rises instantaneously to a velocity of 133.3 ft. per sec., continues at this velocity for a definite time interval, then drops instantaneously to zero, remaining so for the same interval. The average velocity of such a wave is 66.67 ft. per sec., and the volume flowing is correctly given by multiplying this velocity by the cross-sectional area of the duct.

With pitot-tube measurements quite different results would be obtained. With an air density of 0.075 lb. per cu.ft., the 133.3 ft. per sec. would be equivalent to 4 in. of water. The average velocity pressure of the pressure wave is 2 in., and this would be registered by the U-tubes. The velocity calculated from this indicated 2 in. is 94.2 ft. per sec. Because of the assumptions made, the average velocity was only 66.67 ft. per sec., so that a volume 41 per cent high would be reported.

If the pulsations were in the nature of a sine wave, in which the velocity varies from zero to a maximum value,

the reported volume would be in error by 22½ per cent. If the sine wave pulsation does not drop to zero, but to a minimum value *a*, the possible error will be less than 22½ per cent. If this minimum velocity *a* is equal to four times the wave half amplitude, the error will be 1 per cent.

Thus, the way to correct this apparently lies in keeping a high ratio of *a* to the half amplitude. This condition is most readily secured by the use of a flow nozzle, at the mouth of which all the head is changed into velocity. In the tests that were made, using an instrument especially developed for the purpose, the amplitudes of vibrations or pulsations measured were found to be substantially the same in the mouth of the nozzle as in the duct at the position where pitot tube traverses are usually made. At the mouth of the nozzle the average velocity is high; *a* likewise is high, and the controlling ratio of *a* to the half amplitude being large, produces a small and perhaps negligible error.

Test procedure, therefore, ought to result in a determination of the presence or absence of pulsation error. With the instruments at present available, this information can best be secured by comparing two volume determinations, one by the usual pitot tube traverse, and one by a nozzle determination at a higher velocity.

Mr. Hagan's paper evoked much discussion. Many of the discussers expressed the belief that the paper did not include sufficient data to indicate conclusively that the difference between volume measurements made with a pitot tube traverse and a nozzle was due entirely to the effect of pulsations in the flow of air. One discusser indicated that in his belief the vibrograph records, reproduced in the paper, showed an error of only one-half per cent due to pulsation, whereas there existed a 7 per cent difference in the volume indicated by pitot tube readings the that indicated by nozzle.

Another speaker attributed such differences to turbulent conditions of flow which would affect the pitot tube results more than it would affect the results from nozzle measurements.

Several engineers related their experience in attempting to measure flows that were extremely pulsating, and in all cases found that the results of their efforts gave indications of flows that were known to be too high.

In closing the paper Mr. Hagan pointed out that the main purpose of the paper had been to show that differences existed between measurement of airflows by pitot tube traverse and those measurements made by nozzles. He explained that the Vibrograph had been included in the paper merely as an illustration, to show that pulsation did exist, and that the magnitude of pulsation error could not be determined from it, because too many other variables existed.

Influence of Bends on Performance of Fans

AT LAST year's annual meeting, Professor Marks presented a paper, in which were reported the results of tests on the influence of the inlet box on the performance of the induced-draft fans. During the year work of this nature has been expanded to include tests showing the influence of the ducts leading the gases to the inlet box. The results of these tests were presented in a paper by L. S. Marks, John Lomax and Randolph Ashton.

The double-inlet 38-in. dia. radial tip fan used for these tests was the same as the fan used in the tests reported last year. In the majority of the tests the modified rectangular inlet box was used. This had been found to give a performance practically identical with the performance obtained with free inlets. In a few tests a scroll inlet box with guide vanes, which had been found to reduce the capacity of the fan about 30 per cent, was substituted for the rectangular box.

Three types of bends were used, long-sweep, 45- and 90-deg. bends, and square elbows. Each bend was tested in two positions, (1) so oriented as to cause general flow of the air through the bend to have the same direction of rotation as the rotation of the fan wheel, and (2) with the bend turned through 180 deg. so as to reverse this general direction of flow.

The loss in capacity for 90-deg. bends is approximately twice the loss with 45-deg. bends, and the loss in square bends is quite large, being in one case almost twice that of the 90-deg. long-sweep bend. In the square bend both the inner and outer surfaces of the bend form right angles. The capacity was also found to be greater when the direction of air rotation in the bends is opposed to the direction of rotation of the wheel.

The direction of the bends has a very marked effect upon the static efficiency. The maximum static efficiency fell from 64 per cent, with a straight duct, to 55 per cent with 45-deg. and 90-deg. bends, and to 52 per cent with square bends, when the air rotation was opposed to wheel rotation.

Guide vanes used with the square bends restore nearly the full capacity with opposed direction of air flow, but with some loss in efficiency, and with the same direction of air flow give full efficiency, but with some loss in capacity. Three guide vanes, giving an aspect ratio of 0.8, were found to give as good fan performance as seven guide vanes.

Fan performance was also investigated when short length of straight ducts were inserted between the fan and the 90-deg. long-sweep bend. Two lengths of short duct were used, one 5 ft. 5 in. long, and the other, 10 ft. 5 in. long. The shorter length of duct was found practically as effective as greater lengths, and in both cases nearly half of the loss in capacity is restored, and the loss in efficiency is in large part regained.

When a scroll inlet box with guide vanes is used, it was found that the bends have very little influence upon the performance of the fan when compared with the performance of the fan with scroll inlet and straight duct to the inlet box. This advantage of the scroll inlet box is obtained at the cost of considerable reduction in capacity, but with a marked increase in maximum efficiency when the air rotation in the bend is opposed to the direction of the wheel rotation.

In the discussion it was suggested that considerable work might be done to improve the design of the right-angle turn and guide vanes used, and that the effect of discharge connections on the fan's performance should be determined in the same way as the effect on performance of inlet connections. In reply, Professor Marks said that such work was contemplated.

Test Codes

AFTER the previous two papers had been presented, and the discussion closed, the Test Code for Centrifugal Compressors, Exhausters and Fans was presented for public hearing. This Code has been prepared in two parts, the first part dealing with the testing of centrifugal compressors and exhausters, and the second part dealing with the testing of fans.

Discussion of the Test Code was opened by a plea to permit the use of orifices for measuring the volume instead of restricting this to the use of nozzles only.

It was pointed out that the thermometer and pitot tube, in some of the installation diagrams presented, came too close to the nozzle, and in the position shown might cause errors in results.

It was pointed out that the coefficients of discharge seemed to disagree with values given in the fluid meter report. Some discussion developed on the methods to be employed in converting the results of tests made on air to the results that would be obtained when using a gas of different density.

In discussing Part 2, relating to the testing of fans, Dean Anderson made a plea to combine the Test Codes of the A.S.M.E. and the A.S.H.V.E., and hoped that the A.S.M.E. would go slow in adopting a Mechanical Engineering Test Code for fans, without first cooperating with those experts in air-flow measurements who had assisted in the preparation of the Code now in use by the Heating & Ventilating Engineers.

A resolution was passed at the meeting to form a new committee which would deal with the preparation of a test code for fans, separating it from the test code relating to centrifugal compressors and exhausters.

LUBRICATION—STEAM—FEED WATER

Vertical Journals

IN A session devoted to lubrication problems, practical data for the friction power of vertical journal guide bearings were presented by A. I. Ponomareff of the Westinghouse Electric and Mfg. Company and Prof. E. D. Howe of the University of California. This information has been greatly needed, particularly in the design of deep-well pumps where the guide bearings may absorb as much as five per cent of the power.

A formula was developed involving oil viscosity, journal dimensions, clearance and speed. Experimental work closely checked the theory. The accompanying chart for the friction power of such bearings is therefore in close accord with both theory and practice.

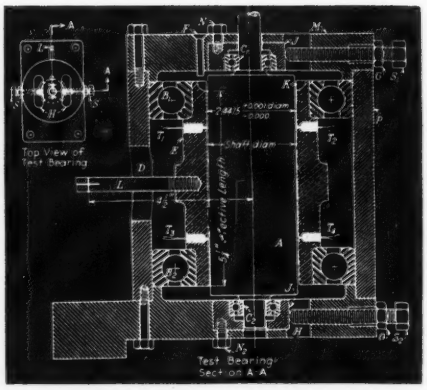
Chemical Theory of Lubrication

IN THE same session W. F. Parish, chairman of the A.S.M.E. Lubrication Committee and Leon Cammen, consulting economist, presented a paper on the chemical mechanism of lubrication. As expounded in masterful fashion by Mr. Cammen, this theory is grounded in physical chemistry and starts with a study of the molecules of metal and lubricant and their fields of energy. The paper stated that every lubricant consists of a true lubricant and a solvent matrix which acts as a carrier. A new lubrication tester was described and a new basis proposed for lubrication specifications.

Steam Research

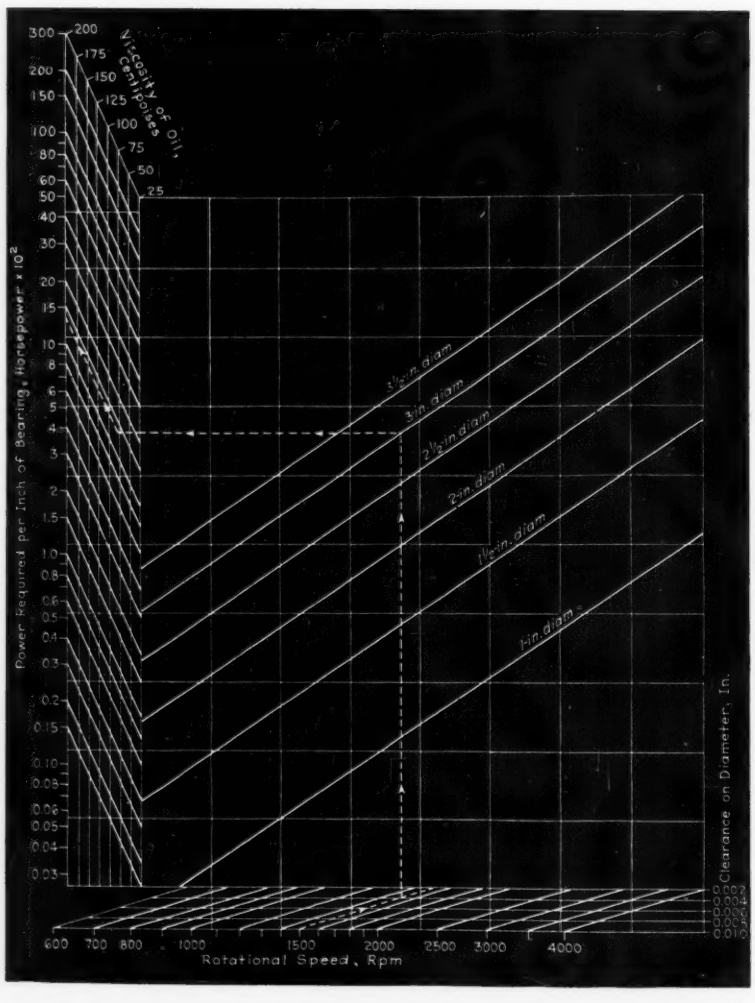
EACH year, at the annual meeting, the Special Research Committee on Thermal Properties of Steam has met, discussed progress and laid out new plans. This year's meeting was the usual stimulating contact of brilliant experts in steam experimentation and formulation. The experimental work at the Massachusetts Institute of Technology is practically complete, although analysis of the data obtained is continuing. The first investigation at the U. S. Bureau of Standards was completed several years ago. The latest, according to the report of N. S. Osborne, is progressing rapidly, and should extend for not more than another year or a year and a half, to complete the field of work now laid out.

Discussions by Mr. Osborne, by Prof. Keyes of M.I.T., and by Prof. Keenan of Stevens Institute, showed that American and European experiments have developed a great mass of mutually checking data for the complete saturation line of steam and liquid water and for much of the important region over the steam dome.



Working parts of test apparatus used in studies of power required by vertical guide bearings

Power required by a vertical journal bearing per inch of length



Boiler Feed Water

AT THE meeting of the Boiler Feed Water Committee, Sheppard T. Powell, chairman, announced completion of tentative arrangements for co-operative research between the Bureau of Mines and the Boiler Feed Water Studies Committee, to study the solubility equilibrium of sodium sulphate in concentrated boiler water. The estimated expense for the next two years is $7,500 per year.

Work will continue at the University of Michigan on methods of boiler feed water analysis and at Ohio State on priming and foaming.

Mr. Powell announced the appointment of Capt. H. R. Greenlee, director of the U. S. Naval Experiment Station, as a member of the Executive Committee. Extensive practical research on boiler feed water conditioning is in progress at the Naval Experiment Station.

PURE AIR COMMITTEE CONDUCTS SETTING HEIGHTS SESSIONS

ACTING in its capacity as a clearing house and forum for the discussion of problems pertaining to atmospheric pollution, the A.S.M.E. Pure Air Committee held an all-day session Friday, Dec. 9. The meeting brought together the principal manufacturers and smoke law enforcement authorities for the purpose of discussing the setting heights of small boilers.

It is generally known that there are wide differences of opinion among these groups as to what setting heights are suited to so-called "smokeless" combustion. Three separate recommended tables of setting heights were presented by as many interests. The Midwest Stokers Association report was presented by T. A. Marsh, chairman of its Engineering Committee. C. E. Bronson, representing the Steel Heating Boiler Institute, offered the standards which that body adopted and put into effect in revised form Nov. 19, 1932. The boiler setting heights sub-committee of the Pure Air Committee offered a tabulation of setting heights which it recommended.

Those present to consider the subject as a whole were the authorized representatives of: the Midwest Stoker Association, T. A. Marsh; National Coal Association, J. R. Evans; Advisory Board of Engineers, Department of Smoke Inspection & Abatement of Chicago, T. A. Marsh; Fitzgibbons Boiler Company, H. Almert; Heating & Piping Contractors, William W. Hubbard, Anthracite Institute, A. J. Johnson; Department of Smoke Regulation of Hudson County, Wm. G. Christy; Stoker Manufacturers Association, John Van Brunt; Steel Heating Boiler Institute, C. E. Bronson; American Boiler Manufacturers Association, Geo. W. Bach; A.S.M.E. Fuels Division, Prof. L. E. Seeley; Department of Smoke Abatement, Stevens Institute of Technology, Col. E. H. Whitlock; Smoke Prevention Association, Chicago, Martin A. Rooney; American Society of Heating & Ventilating Engineers, James F. McIntyre; Institute of Boiler & Radiator Manufacturers, F. W. Herendeen and acting for the Pure Air Committee: J. W. Armour, Riley Stoker Company; Geo. W. Bach, American Boiler Manufacturers Association; Dr. O. P. Hood, U. S. Bureau of Mines; Col. E. H. Whitlock, Research Professor, Department of Smoke Abatement, Stevens Institute of Technology; Ely C. Hutchinson, Editor of *Power*, Chairman.

Despite the difference of viewpoint and the very active discussion which occupied the full day, a splendid spirit of cooperation prevailed. There was unanimous opinion that the time was ripe for a united effort to establish a single national standard of setting heights for small boilers, that is to say, boilers of 200 hp. and under. In order that no persons or groups whose interests would be affected by the establishment of a national standard shall be neglected it was voted by those present at the meeting that the good offices of the American Society of Mechanical Engineers should be enlisted to present to the American Standards Association a plan that the setting heights standardization be carried out under the procedure of that body. Those present at the meeting considered this to be a great forward step toward the solution of a problem that has long perplexed the small boiler industry and the smoke law enforcers.

Oil & Gas Power

(Continued from page 338)

and similar additions. Though over 90 per cent of Sulzer's production is mechanical injection engines, there are nevertheless those types of services where the air injection engine apparently works better and probably will continue to be preferred by them for those situations because of dependability and ease of maintenance. Air injection also offers more range and flexibility in these situations, the extra or super scavenging and added turbulence of the air injection apparently aiding the combustion process.

Diesels for Small Boats

Since the paper under the above title was limited very closely to its subject, it had but little general power interest. The discussion on supercharging which resulted, however, was decidedly interesting, since it referred to diesel engines generally. Some 266 small boats have adopted diesel drive during the first eight months of this year, 759 have been converted within the past several years, making a total of 1,066 more diesel-driven small boats than the 2,219 listed in the paper.

Sanford A. Moss of General Electric asked the same question recently stated in *Power* (November, page 232)—why do American engine builders hesitate to use superchargers when so many European companies use them successfully. Several discussers informed Mr. Moss that the supercharger added complications which small-boat operators in particular could not be expected to master; that they added economies which were not worth serious consideration because of the low price of motor fuel; that our engines tend to be simple, reliable units while foreign diesels are excessively complicated. Other less important reasons were also given. One European engineer expressed the opinion that foreign diesel owners must pay so much for their fuel that they demand maximum economy—economy which means added complications that the American does not consider entirely necessary. His opinion was that many a European small boat could make an entire fishing trip on the fuel oil that an American ship wastes overside.

Supercharger advocates brought forth the facts that weight per b.hp. is cut appreciably when a supercharger is used, since superchargers can be added which will step up engine power as much as 50 per cent with but a slight weight increase. Further, costs for superchargers run $5 to $7 a hp. (*Power*, November, page 233). They claim the supercharger is not a complication, for all it adds are a few gears, two shafts, and an impeller in the simplest type, and it permits a smaller engine with fewer cylinders and a consequent reduction in the number of pistons, connecting rods and weight of crankshaft. They felt that manufacturers would probably be forced to use superchargers when the market demand for diesels, say of over 700 hp., is sufficient. Low weight is particularly important for marine, aircraft and automotive installations, and this means increase in speed and use of supercharging with present engine design. Use of superchargers may be expected to extend into smaller engines as the necessity for lower weight grows.

Trunk pistons versus adoption of the double-acting principle elicited the opinion that this was a matter of size and relative efficiency and that no hard and fast rule could be laid down. Men not connected with the diesel industry also brought up comparative diesel engine and gasoline engine costs, citing the fact that boat owners could only be sold unanimously on the diesel if it offered better service efficiency at a comparable cost, even though its lower fire hazard and lessened fuel consumption are to its advantage.

"CREEP" AT HIGH TEMPERATURES

Designing for Creep

WITH the advent of high steam pressures and temperatures a few years back came immediate and intense interest in the effect of high temperatures upon metals subjected to continuous or intermittent stresses.

Studies made in previous years have developed a whole new technology of "creep."

The working stress symposium on Monday afternoon gave full recognition to the importance of this subject, and materially advanced the knowledge of it. Papers were presented by G. H. MacCullough (Applications of Creep Tests) by P. G. McVetty (Factors Affecting Choice of Working Stress for High-Temperature Service), and by Ernest L. Robinson (Metals at High Temperature — Test Procedure and Analysis of Test Data). G. H. MacCullough, professor of engineering mechanics at Worcester Polytechnic Institute, showed the designer's approach to four specific problems: namely, that of the flanged and bolted pipe joint under creep conditions, and the three problems of stress distribution and creep in thick-walled cylinders under internal pressure, in a beam subjected to pure bending and in a solid circular shaft under torsion.

Where the design problem is merely one of securing the necessary strength, Mr. MacCullough indicated that fairly satisfactory results may be obtained by a simple method involving the use of a definite fraction of the stress found safe for some lower temperature. For example, in the case of steam plants, considerable experience exists for an initial temperature of 750 deg. F. Creep tests indicate that for the same carbon steel, and the same creep rate, the stress at 850 deg. F. is approximately 60 per cent of that for 750 deg. While this simple method takes no account of the redistribution of stress and other factors, it gives results generally on the safe side.

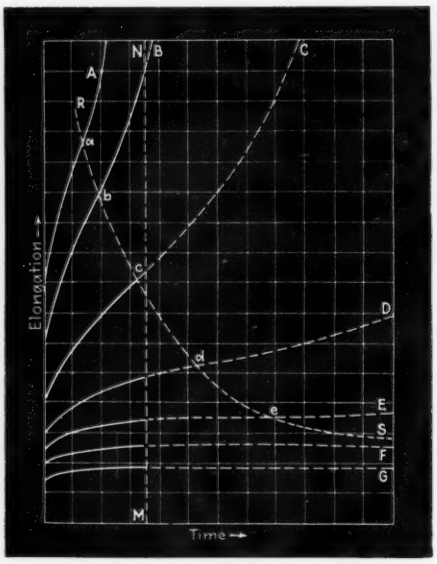
Back to Fundamentals

A note of warning was sounded by P. G. McVetty, of the Westinghouse Research Laboratories, East Pittsburgh. His paper contained no specific data on metals, but, rather, was confined entirely to a discussion of fundamentals. These, Mr. McVetty stressed, have been largely overlooked in the rush to develop stress and creep data to meet the insistent demands for high temperature design.

He pointed to the immense amount of data that has been accumulated, and expressed regret that the basic definitions have not been agreed upon, and no standardized method of testing has been accepted. It is time, said Mr. McVetty, to get back to first principles and establish not only standard creep and stress tests, but also rational methods of interpreting them.

The chief difficulty, he said, is that equipment is designed for a life of 20 years or so, while it is obviously impracticable to prolong creep tests for such periods. The result has been that creep tests extended no more than 1,000 hours have been applied to the designs intended to be used for 100,000 hours. Creep tests, particularly at the lower temperatures, have shown a steadily increasing creep rate for a certain period, and then a practically constant rate. Mr. McVetty pointed out, however, that eventually the rate of elongation increases once more.

The relation is shown in the accompanying diagram. For the higher temperatures, represented by curves A, B and C, this recurving will probably occur within the expected life of the material, that is, before *MN*. In such cases, designs based on rates "discovered" in shorter tests may be unsound. At lower temperatures the point of recurving may be safely beyond the expected life of 20 years, or thereabout. Mr. McVetty asked for studies to determine, if possible, the relation between these points of recurving and the other factors involved. Until this is done, he said, there is constant danger that designers, without analysis, will apply the sort of creep rate data which specifies a fixed creep rate for any given temperature and stress.



G. H. McVetty presented these curves showing that at high temperatures (upper curves) creep rate may increase within useful life (before *MN*)

He indicated that during long periods of service there may be structural changes in the metal which do not occur in short-time tests. These call for further metallurgical study. He suggested that much might be discovered by tests made at higher temperatures than those of expected service, for example, at temperatures which would give, within the test period, an elongation equal to that expected for the lower temperatures during the entire useful life of the equipment.

Long-Time Creep Tests

Test procedure and analysis of test data for metals at high temperature were discussed in the final paper by Ernest L. Robinson, of the Turbine Engineering Department of General Electric Company.

On the basis of tests made in the General Electric Laboratories, Mr. Robinson agreed with Mr. McVetty as to the danger of applying to a 10- or 20-year period the results obtained in a one-year test, or of applying the results of a one-day test to a full year. Already the General Electric Company is carrying into the second year tests made on selected promising material.

In presenting his paper, Mr. Robinson emphasized the difficult position in which designers are placed by the fact that the many avaliable tables of creep data are based on a variety of test methods and unaccompanied by adequate statements of test conditions.

Unlike Mr. McVetty, he did not attach great importance to the point of recurving in the creep curves. He has found no case where this occurred at less than 1 per cent elongation which, he said, is ten times the permissible limit in most designs.

In the discussion, Mr. McVetty also emphasized the sensitivity of creep data to small temperature changes and recommended that designers base designs for creep on the maximum temperature to be encountered rather than on the average.

He urged further study of flange creep and suggested a critical attitude toward the extrapolation of creep-test curves. Referring to Mr. Robinson's opinion that points of recurving are not of practical importance, he said these would fall within the life of the equipment in certain fields, for example that of oil refining.

Mr. Speller of National Tube Co. referred to cooperative research aiming to set up standards of test procedure. Agreement upon such standards, he felt, will make it easy to get research funds.

A. A. POTTER

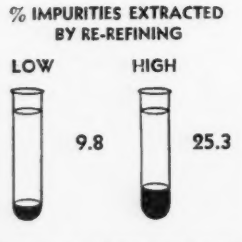
President

A. S. M. E.

TIDE WATER RE-*refines*

DEMONSTRATES TYCOL'S

Tide Water's Special Edeleanu Process completes jobs left unfinished by ordinary refining methods.



If you are having trouble with turbine or Diesel lubrication, the answer may be: *incompletely* refined oils. Here are the laboratory facts. Tide Water bought, in the open market, 12 leading competitive brands of turbine and Diesel oils and re-refined them by the Edeleanu Process.

These 12 oils were found to contain from 9.8% to 25.3% sludge-forming extracts (removed by re-refining). These extracts had oxidation numbers ranging from 144 to 399. The original oils themselves had an average oxidation number of 43 . . . re-refining lowered this to 5.

That's proof that the Tide Water Edeleanu Process completed the jobs left unfinished by usual refining methods.

TIDE WATER'S PROCESS REFINES COMPLETELY

Why is Tide Water's Process able to do this . . . to produce results so far beyond other methods?

The reasons are: The Process is a physical solvent treatment. It dissolves ALL unstable hydrocarbons, found even in the best of crudes. It starts NO chemical reaction upon the components of oil, stable or unstable. It forms NO new unstable substances. And it preserves the pure and stable hydrocarbons of highest lubricating value.

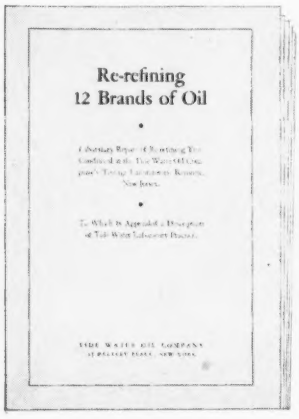
That is why Tycol Turbine and Diesel Oils, being 100% paraffine base, and refined by this Process, have purity and stability which no other oils possess; Tycol Oils have oxidation numbers ranging from 1/4 to 1/50 of those of competitive grades.

GO BY TYCOL'S SERVICE RECORDS

In the final analysis, it is service that counts. Everything shown in these laboratory tests is borne out by experience. Tycol oils have set up new records of performance for some of the country's leading producers of power.

Based on these records, you can depend on Tycol oils for low acidity, low carbon deposition and better demulsibility. You can depend on them for stability, for non-sludging, long-lasting, efficient, economical lubrication!

GET THE LABORATORY REPORT



All of these facts and many more (all pertinent to the user of turbine and Diesel oils) are fully reported in Tide Water's recently published Laboratory Report, "Re-refining 12 Brands of Oil." Send for it. Address Tide Water Oil Sales Corporation, 17 Battery Place, New York City, New York.

12 *Competitive Oils*

GREATER DEMULSIBILITY

KNOW YOUR OILS

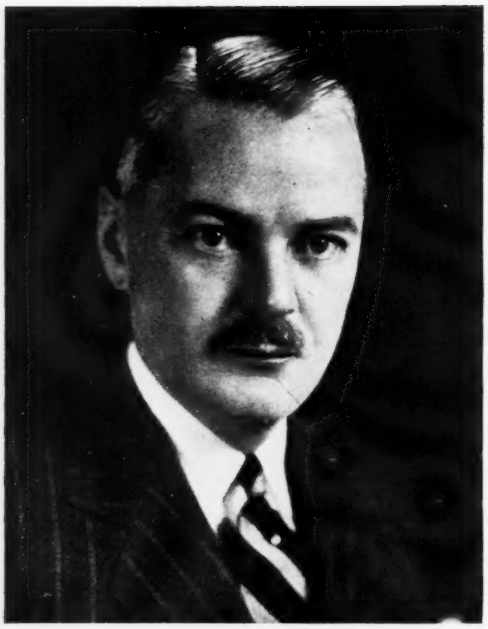
So sure is Tide Water of Tycol superiority, that it is making an unprecedented offer to buyers of turbine and Diesel oils. Tide Water will be glad to *re-refine for you,* by its Edeleanu Process, a sample of the turbine and Diesel lubricating oils you are now using. Not only that, Tide Water will welcome the presence of your own technologists at the time.

■ *Tycol's greater demulsibility is proved in the Steam Emulsion Test. This test determines the rapidity with which oil will separate from condensed steam . . . a very important requirement in turbine operation.*

INDUSTRIAL
TYCOL
OILS-GREASES

TIDE WATER

NEWLY ELECTED



J. D. CUNNINGHAM
President, Republic Flow Meters Co.

• This year, The American Society of Mechanical Engineers elects three vice-presidents and three managers, the three vice-presidents to serve for two years, the three managers to serve for three. Next year, four vice-presidents will be elected. Thus there are at all times seven vice-presidents and nine managers of the Society, and the president, who serves for one year, as elected officers. A. A.

HAROLD V. COES
Manager, Indus. Dept., Ford, Bacon & Davis

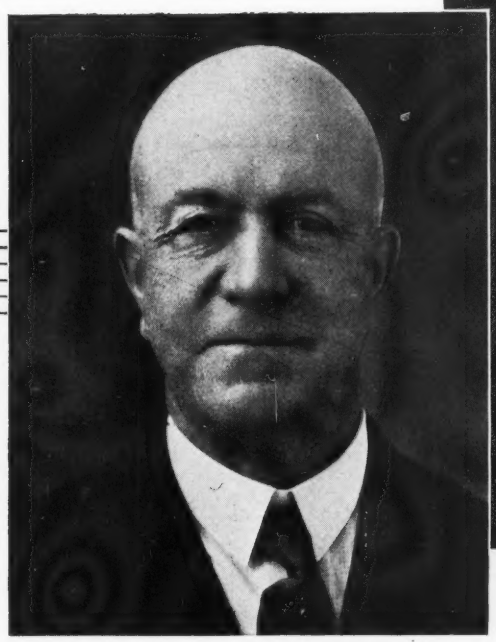
C. F. HIRSHFELD
Chief Research Dept., Detroit Edison Co.

A.S.M.E. Officers

Potter, newly elected president, whose photograph appears on page 347 of this number, is Dean of the Schools of Engineering at Purdue University. The professional connections of the other officers are listed with their photographs. The three new vice-presidents, all of whom were formerly managers of the Society, are pictured at left, the three newly elected managers at right.

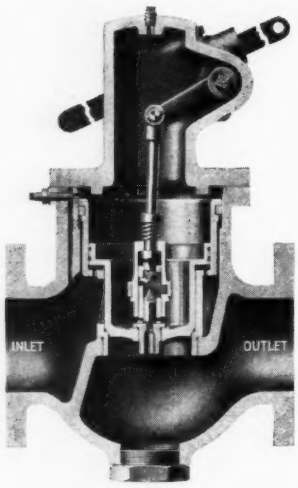
ALEX D. BAILEY
Supt. Gen'l'ng Stat'ns
Com. Ed. Co., Chicago

JOHN A. HUNTER
Prof. of Mech. Engrg.,
University of Colorado



R. L. SACKETT
Dean, School of Engrg.,
Penn. State College

COCHRANE



Pilot Operated Regulating Valve

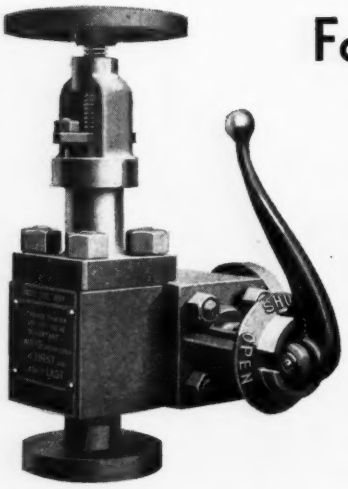
Tight under high pressures

A float on the water level in the tank, heater or other vessel to or from which flow is being controlled actuates a small pilot valve, which controls pressure on a plunger connected with the main flow regulating valve. The latter follows up the motion of the pilot, and therefore of the float, without back-lash or over-shooting, resulting in smooth variation of flow with change in position of the float. An auxiliary multiplying lever enables a small float with limited travel to control the pilot accurately under high pressures, while retaining a high lift of pilot and main valve. When closed, both main valve and pilot are held to seat drop tight by pressure, preventing the leakage characteristic of so-called balanced valves.

A dampening chamber effectively prevents chatter.

The rotary spindle can be on either side of the valve body, giving eight different locations for the operating lever.

Ask for Bulletin L-696



Forged Steel, Tandem Boiler Blow-Off Valve

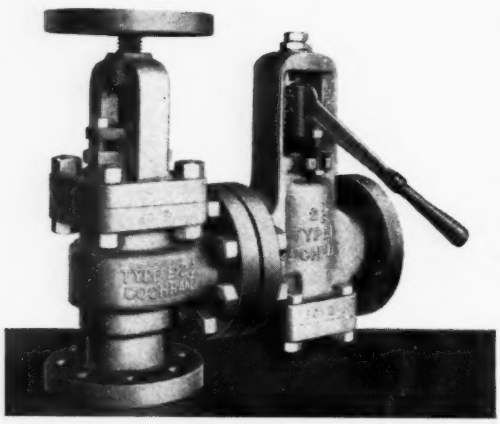
for highest pressures

The virtue of this blow-off valve is that it STAYS TIGHT, which result is attained by metal-to-metal seating of clean, hard surfaces and by protection of the rotary gate valve and of the main screw-down valve from the action of the blow-off flow, with no wire drawing. Valves in use for periods of 1 to 5 years under pressures ranging from 385 to 1850 lbs. per sq. in. are still giving first-class, drop-tight service, without regrinding or other repair or expense. One group of these valves has been opened and closed no less than 5,000 times under 400 lbs. pressure.

Both the rotary valve and the screw-down valve are combined in a unitary forged steel body, without joints or gaskets.

This valve is designed for the highest pressures and temperatures.

Ask for Bulletin L-691



Tandem Blow-Off Valve

for pressures up to 400 lbs.

This valve embodies the rotary gate and screw-down features of the forged steel valve, but the body is made of cast steel for pressures of 400 lbs. and under and of Nicromiron for pressures of 250 lbs. and under. Either part of the unit may be used independently or with any other satisfactory valve, but for new boilers the combination tandem valve should be used in order to combine the advantages of the easily operated, quick opening Cochrane plug valve and of the improved Cochrane screw-down valve, which together insure drop-tight service over long periods. The two valve bodies may be bolted together at any angle with respect to one another, as determined by the bolt spacing, or the plug valve may be reversed to bring the handle on the opposite side.

Ask for Bulletin L-693

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VALVES

Multiport Back Pressure Valve
meets ALL requirements

1. It does not clatter or pound.
2. The back pressure can easily be adjusted or relieved.
3. A maximum pressure, which is fixed when the valve is built, cannot be exceeded, nor can the valve be tied shut or become jammed.
4. The combined cushioning plungers and valve disks are above the valve deck, where they are readily accessible.
5. The valves can be ground to seat while in place.
6. The cushion chamber does not accumulate grease, grit or scale, and does not require water; hence the valve can be used with superheated steam or air.
7. Built for horizontal, vertical or angle pipes, and for pressures up to 125 lbs.

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Above: Showing springs slightly compressed for light back pressure

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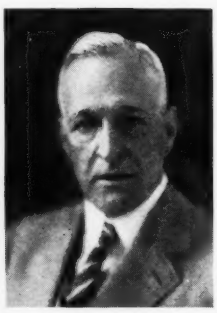

I. E. MOULTROP, *Chairman*
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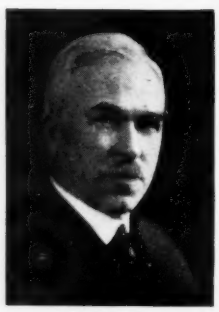

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TENTH NATIONAL POWER SHOW

REFLECTS IMPROVED OPERATING FEATURES

Refinements to increase efficiency, to obtain greater accuracy, and to improve operation were features of the exhibits at the National Exhibition of Power & Mechanical Engineering, in New York during the week of Dec. 5

A DECADE of power development has been lived through since the first National Exhibition of Power and Mechanical Engineering was held in New York City in 1922. Even though the Tenth Power Show may have lacked some of the large exhibits and equipment of former years, it nevertheless reflected marvelous achievements in power generation and application. High temperatures and pressures were very much in evidence in the valve and the refractory exhibits. Most of the new equipment displayed has been described in *Power* in previous numbers and will also be found in the Review of New Equipment following this article.

The trend toward improved operation was very apparent in the large number of exhibits of meters and automatic control for almost every purpose in power generation and industrial processes. A large part of the show was devoted to exhibits of this character.

Although this year's show was not as large as in former years and clearly indicated the desire of most manufacturers to restrict their expenses, it was none the less a valuable source of information to engineers. One of the most noticeable effects of the depression was the lack of large equipment exhibits so prominent in other years. Only one medium-size stoker was demonstrated and no pulverized coal equipment was shown. What was lacking in exhibits of this kind was more than compensated for by the large displays of cross-sectional photographs and drawings of large equipment and plants.

As an example of this one manufacturer displayed cross-sectional drawings through seven different types of boiler plants. These included plants of both the indoor and outdoor type, the later being the very latest advance in plant design. These drawings were in several colors to clearly indicate the flow of fuel, air, water, steam and the gases of combustion. The automatic combustion-control equipment installed to regulate these plants was also included on the drawings, so as to give a complete picture of the plant's operation.

Models of equipment were also displayed. One of the best examples of this type of display was a cross-section of one of the boilers in the Pennsylvania Sugar Company's plant in Philadelphia and described in the August number of *Power*. These boilers each have a normal steaming capacity of 250,000 lb. per hr. and have produced more than 350,000 lb. per hour. A complete detailed model of one of the boilers was shown to display all parts of its construction, the boiler, water walls, superheater, economizers, air preheaters, coal pulverizing and combustion equipment including the forced- and induced-draft fans.

Another outstanding feature of the show was the large number of different pieces of equipment shown in sections. These included water walls, furnace construction, a tube section from one type of mercury boiler, high-pressure evaporators, heat exchangers, pumps, valves, traps, metering equipment and many other types of apparatus. Most of the booths that exhibited power equipment had on display several pieces of equipment in section. A great deal of attention was given, in equipment not shown in section, to having working

parts either displayed or arranged so that they could be easily exposed for inspection.

As a result of this tendency toward good showmanship, even though the show lacked much of the spectacular character of former years, it offered ample compensation in its instructive displays. In the latter feature, which is the criterion of a successful show, this exposition was superior to those of previous years.

Smoke Elimination

The increased attention that is being given smoke elimination during the last few years was manifested at the show in the exhibits. One exhibit in which Stevens Institute of Technology, the Mellon Institute of Industrial Research, the U. S. Weather Bureau in New York City and other bodies participated, was devoted to the work done to eliminate smoke and how it has been accomplished. This exhibit gave recognition to the work of the Pure Air Committee, a central body of public-spirited professional engineers through which all matters of air clarification involving engineering may be cleared. Its meetings are technical forums for the mutual discussion and rectification of pure-air problems. It supervises and sponsors research and serves as a clearing house for research information within its scope.

At the Stevens Institute exhibit was displayed a chart showing what the railroads in Hudson County, N. J., have done to eliminate smoke. Beginning with April, 1931, the smoke density from 1,100 locomotives in 9 railway yards was 23 per cent on a Ringlemann chart. At the present time the average density is down to 2.8 per cent. Smoke density recorders were demonstrated at some of the meter company booths, and a manufacturer of power plant equipment showed a section of a new type flue-gas scrubber. This scrubber consists of a series of ribbed plates so located as to cause the flue gas to impinge against them during its passage through the scrubber. A thin film of water flows over the surface of the plates and as the flue gas impinges against them, the water carries away the fly ash and cinders. During tests 90 per cent of the fly ash in the flue gas from a pulverized-fuel fired boiler was removed by the scrubber.

In line with the pure-air movement, one of the largest exhibits at the show consisted of air-conditioning equipments displayed by one manufacturing company.

Thermodynamic Motor Draws Power From Atmosphere

One of the most novel exhibits and one that attracted a great deal of interest was the vacuum vapor power plant in the Cochrane Corporation's booth. This device, which is shown in the diagram and photo, has, on casual investigation, the earmarks of perpetual motion, but in reality is a miniature very low-pressure steam plant.

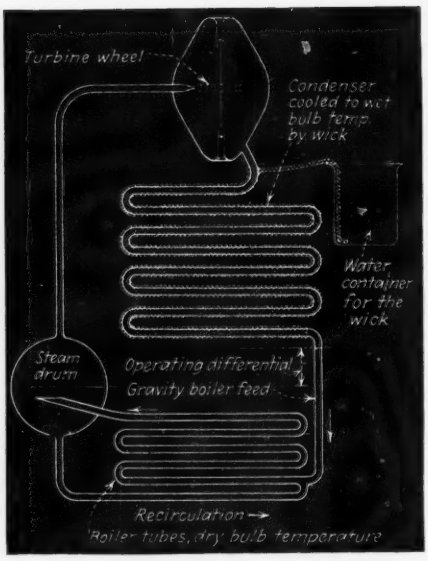


Diagram of the vacuum vapor power plant

The vapor-turbine power plant utilizes the difference in temperature generally existing between the indications of an ordinary theremometer and that of a wet-bulb thermometer, that is, one in which the bulb is kept wet by a wick dipped into water. The dry-bulb thermometer indicates the actual temperature of the atmosphere, while the wet bulb shows approximately the temperature of saturated water vapor or steam at the pressure which is being exerted by the superheated water vapor present in the atmosphere.

This difference always exists, except in a saturated atmosphere. In homes heated during the winter months and in arid climates the difference between wet- and dry-bulb temperatures may be 20 deg. F. or more.

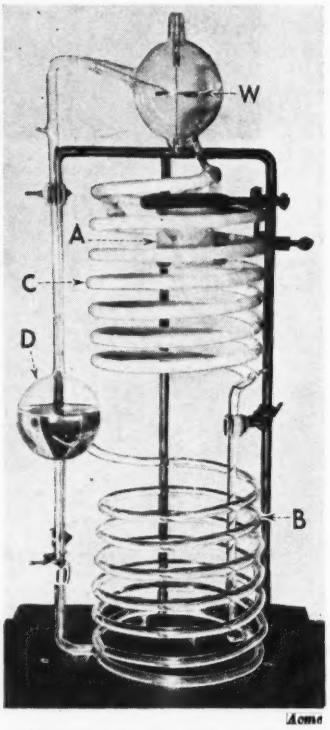
The vapor turbine plant consists of a boiler *B* and drum *D* in which steam is generated by the heat of the surrounding atmosphere, a nozzle through which the steam jet impinges upon the buckets of a turbine wheel *W* mounted in jeweled bearings, and a condenser *C* cooled by a wetted wick that dips into water in the cup *A*. The general arrangement of the different parts is clearly shown in the diagram and photo.

The condensate returns to the boiler by gravity and with the equipment in an ordinary atmosphere the turbine wheel will spin indefinitely so long as the wick is kept moist. Why this is so readily understood when it is realized that in a vacuum of 29.5 in. water boils at around 60 deg. F. Inside the vapor turbine power plant a vacuum of that order is maintained.

Some of the chief data of the plant are: boiler heating surface 1.88 sq.ft., condenser surface 1.25 sq.ft., temperature difference assumed between dry and wet bulb 10 deg. F., temperature difference between steam in boiler and in the condenser 3 deg. F., difference in steam pressures between the outlet and inlet of the boiler one inch of water column, spouting velocity of the steam from the turbine nozzle 600 ft. per sec., diameter of the nozzle 0.002 in., steam flow 0.004 lb. per hr., horsepower of the jet 0.000016, Rankine-cycle efficiency, one per cent.

Metering Equipment

The metering equipment manufacturers formed one of the largest single groups of exhibitors. How important exact knowledge of power-plant and process operations are, if high efficiency is to be maintained, was illustrated by the great variety of purposes for which metering equipment is available. Continuous records may be had of almost any operation and automatic control provided to maintain any desired results. Not only can the quantity be metered but the record may be given at any distance from the source.



Acme

Photograph of the vacuum vapor power plant as exhibited at the Power Show

A meter exhibit that bordered on the spectacular, yet was a practical commercial installation, was a new type of long-distance metering equipment. This system consists of a sending and a receiving metering unit. In this demonstration one sending unit was in the East River plant of the New York Edison Company on one of the largest steam generators in operation. Another sending unit was located near Catskill, N. Y., and was connected to a 15-ft. venturi tube in the Catskill aqueduct of

the New York water system. These sending units were connected to receiving recorders and totalizers in the exhibition booth, and a continuous record of flow was obtained over telephone lines that were at the same time being used for communication purposes, without interference to either operation. This equipment can be used to transmit a record of quantities, rates of flow, temperature, pressure, position or levels from any distant point.

At another booth there was in operation an indicating, recording and totalizing flow meter with a new feature in the form of a transmitting meter that permits sending a record of flow electrically to a distant indicator, recorder and totalizer.

Another system of long distant metering was demonstrated as a distant electric-power-load totalizer. In this system the sending unit is a thermal device that heats thermocouples to produce a direct-current potential which may be transmitted over a telephone line and applied to a distant recorder through a potentiometer connection. The output of any number of units may be totalized by connecting their thermocouples in series.

A new distant pressure indicator was shown that uses self-synchronizing motors in the sending and receiving units. As the motor in the sending unit is rotated, that in the receiver follows in synchronism to give the indication shown on the sender.

A recording frequency meter was demonstrated that would record variations in frequency of 0.02 of a cycle. This recorder had an attachment to record the accumulated variations in time due to changes in frequency. By means of this record the operator can at intervals adjust the system frequency to compensate for any slight accumulative variation and thus maintain time 100 per cent correct over any given period.

Centralized Metering

A tendency to concentrate metering devices and records so that comparison can be readily made was in evidence in the several exhibits of meters for recording more than one quantity. One of these centralized metering systems permits concentrating all the essential record on one panel centrally located, irrespective of the distance from the measuring point. A feature of this exhibit was a new multiple recording system that produces coordinated records of flow, temperature, pressure, vacuum, per cent CO_2 and other quantities on a single evenly divided strip chart, thus showing operating conditions at a glance. As many as eight different records can be made simultaneously on a single chart with this system.

Several automatic gas analyzers and recorders were on display, and one company demonstrated a new high-capacity solution for absorbing oxygen in flue gas analyzers. This new solution is claimed to have an absorbing capacity four times that of, and will absorb oxygen four times as fast as, the usual pyrogallic solution.

Motors and Speed Reducers

Among the motor and speed-reducer exhibits, one of the outstanding developments was the tendency toward combining the motor with the speed-reducer to form a single unit. Several of the speed-reducer and motor manufacturers demonstrated units of this type. In one booth units for parallel, right-angle and vertical mounting were shown, to meet any space or machine drive requirements. Where the speed-reducer is the larger of the two, the motor is supported from it. If the motor is the larger, as in the case of small speed reductions, the reducer is supported from the motor.

The reduction in space for these units below that necessary for separate motors and speed-reducers is quite marked. The combined motor and speed reducer is also more simple to install and keep in line with the driven machine. They do have the objection that in case of motor trouble, the motor is not so easily dismantled or replaced as when a separate motor and speed-reducer is used. This, however, is not as serious an objection as might be assumed on first thought, because of the high reliability of modern speed-reducers and motors.

Other exhibits of mechanical-power-transmission equipment included belts for both short- and long-center drives; variable-speed transmission for manual, remote, or automatic control; bearings, chain drives, couplings and gears. A line of silent steel gears were displayed at one booth, the silent feature being obtained by constructing the gear of steel laminations about 0.005 in. thick held between two plates and riveted together under high pressure.

Hydraulic Coupling for Speed Adjustment

One of the large exhibits consisted of a 60-hp. squirrel-cage induction motor connected to a fan through a hydraulic coupling. The hydraulic coupling gives an infinite number of fan speeds from a constant-speed motor, ranging from close to motor speed down to about 20 per cent of that speed. It allows the motor to be started under practically no load conditions and protects the fan wheel from the strains of rapid acceleration when the motor is thrown directly across the line.

The coupling consists of three essential elements, an impeller on the driving shaft, a runner on the driven shaft and a quantity of working fluid, all contained in a single casing. The fluid used is oil and the runner and impeller are similar, both having plain radial vanes in the oil cavity, which serve to sectionalize the oil ring and insure that the oil rotates with the runner and impeller. The runner and impeller run with a distance of from $\frac{1}{8}$ to $\frac{1}{4}$ in. between them, the impeller always running faster than the runner. The difference between the impeller and runner speeds causes a difference in centrifugal force in the two elements setting up a flow of fluid between the two that provides the driving force. Control of the speed is had by withdrawing fluid from or putting it in the coupling casing.

An automatically controlled, high-speed, motor-driven, single-stage blower was one of the largest working exhibits. On the control panel for the motor and fan was a meter with two scales, one showing amperes input to the motor and the other pounds of air per minute delivered by the fan, the pounds of air supplied by the fan being based on the input to the motor. By simply turning a handle, the control can be set for the fan to deliver a given weight of air. After the setting is once made the control will function so that the fan automatically delivers that quantity over a wide range of discharge conditions.

Self-Priming Pumps

The pump exhibits comprised a number of types including centrifugal, rotary, gear, plunger and vacuum heating pumps. The number of self-priming pumps demonstrated indicated a tendency toward this type. In some of these the self-priming feature is made part of the pump's design, where in others a priming device is provided to maintain the pump primed at all times.

A new type of automatic primer was demonstrated that consists of a float chamber connected to the suction line at the pump. This float chamber is connected to a vacuum device to remove the air from the pump and prime it. As the water level rises in the float chamber, the float lifts a rod, which by means of levers open a mercury switch and at the same time a special check valve is closed to seal the float chamber. When the circuit through the mercury switch is open the vacuum producer is shut down. If the water level in the float chamber falls below a predetermined level, the float closes the mercury switch and starts the vacuum producer, and the pump is maintained ready for operation at all times.

Among the new metals shown for the first time was a new alloy of copper and nickel for condenser tubes, and another of copper-beryllium. The copper-beryllium alloy which looks like gold is harder than iron and as strong as steel. This alloy depends on the discovery that copper is hardened by the addition of from 1 to 2.25 per cent of beryllium. It has a tensile strength as high as 190,000 lb. per sq.in. and resists abrasion and fatigue. Copper sheet as thin as paper was another new product and is formed by an electrolytic process.

REFRIGERATION—AIR-CONDITIONING

MAIN TOPICS OF A.S.R.E. ANNUAL MEETING

Water and ice as refrigerants for air-conditioning discussed — Data on refrigeration loads in breweries and cold storage warehouses presented — Thermodynamic cycles for solid CO_2 production compared

THE twenty-eighth annual meeting of the American Society of Refrigerating Engineers was opened at the New Yorker Hotel on Wednesday, Dec. 7, by Glen Muffly, president of the Society. The technical papers presented during the five sessions of the meeting reflected the interest being taken by refrigerating engineers in the refrigerating requirements of air conditioning systems.

Other subjects that received considerable attention were journal bearing lubrication and a comparison of thermodynamic cycles for the production of solid CO_2.

The first session of the meeting was devoted entirely to air conditioning. Mr. Everetts presented a paper on the use of water as a refrigerant. This paper gave some of the history regarding the early use of water as a refrigerant, describing both the Patten system, which employs concentrated sulphuric acid as an absorber, and also the Westinghouse-Le Blanc system.

Air conditioning for comfort requires the most erratic refrigerating load possible. The load is dependent upon people, light, sun effect, outside weather conditions, the inside maintained conditions, and the quantity of outside air used. Air conditioning engineers have been dissatisfied for many years with the conventional refrigerating equipment, because these are not designed or built to give efficient results at the varying loads encountered in air conditioning. The air conditioning system itself has to be designed for maximum conditions which may occur from 4 to 10 per cent of the cooling season. From 50 to 60 per cent of the season the load required may be 50 per cent of the full load, and during one-quarter of the season the load may be as low as 35 per cent. For this reason, and the safe qualities of water, it is being seriously considered as a refrigerant for comfort cooling.

The steam ejector system for using water as a refrigerant is at present the most popular method, and, while considerable thought and study have been devoted to its proper application, considerable information is wanting.

The flexibility of the steam ejector system may be obtained by the use of multiplicity of ejector units. For instance, three jets, properly designed, will give minimum steam rates per ton of refrigeration at seven points along the load curve. Other arrangements of jets may be used employing the variation in condenser pressure to produce a corresponding variation in compression ratio, which will give a lower steam rate per ton of refrigeration effect developed. Partial throttling of the steam to the nozzle, corresponding to small variations in load, may also be used. In this case, however, the steam rate per ton will increase, because it requires more steam as the pressure is decreased to produce the same results.

One of the disadvantages cited against steam ejector refrigeration is the quantity of condenser water required. The heat to be removed by the condenser per ton of refrigeration per hour is the total heat of the steam at the initial pressure less the heat of the liquid at the condenser pressure, plus the 12,000 B.t.u. per ton of refrigerating effect carried over by the vapor. When using steam at 100 lb. gage pressure, and condensing at 2-in. vacuum absolute, 5.5 gal. of water per ton of refrigeration is required when allowing a 15-deg. rise in cooling water temperature. For ammonia refrigeration, when a 10-deg. cooling water range is used, the quantity of water is about 3 gal. per min. per ton.

In discussing the paper, it was brought out by L. Lewis that the steam ejector is particularly adapted for use in air conditioning systems that use surface type coolers. When used with the spray type cooler the spray water is aerated, and hence the load on the air vacuum pump used with the jet system is materially increased.

C. W. Berry described a new development in France, where the evaporation of the water refrigerant is carried on in three stages, thereby improving the economy of the system.

In regard to a question asked by D. Warner, it developed that the mechanical efficiency of the jet is around 40 per cent.

In a paper, "Comfort Cooling With Ice," George B. Bright described the work being done in Detroit in co-operation with the Detroit Edison Co., toward the development of ice for air conditioning purposes. Mr. Bright described several installations of air conditioning systems using ice for the refrigerant, and presented the performance obtained with them.

One of the systems described was in a store in which calculated cooling requirements amounted to 85 lb. of ice per hour. It was disclosed that during the month of August, 12,450 lb. of ice were used. This amounted to 75½ lb. per hour in operation, and the cost of operating the system, including cost of electricity for fans and pumps, amounted to 16½ cents per hour of operation, or 2.2 cents per hour per thousand cubic feet of conditioned volume.

Another system described was that of a sales room of the Detroit Edison Co., in which the system installed conditioned a volume of 5,700 cu.ft., which had a calculated refrigerating load of 1,825 lb. of ice per hour. The cost of installing this system amounted to $6,100. During July and August, 225.8 tons of ice were used, averaging 1,065 lb. of ice per hour in operation. The operating cost, including the cost of 3 kw. for driving fans and motors, amounted to 22.8 cents per hour, or four cents per hour per thousand cubic feet. This is higher than the previous figures, because of a larger lighting and occupancy load.

In reply to a question by A. R. Stevenson, it was disclosed that the plant in Detroit would probably operate about 800 hours a year, and that on some occasions it was necessary to run the system when the outside temperature was as low as 68 deg. The cost of ice varies, depending upon the location of the user, from $3.50 to $5 per ton. Several discussers made a plea for the abandoning of the term "ton of refrigeration," and using instead the "B.t.u. per hour," as a means of rating refrigerating equipment.

The morning session was closed by a paper presented by J. A. Goff, which gave classroom methods of presenting air conditioning theory.

Second Session

Two of the papers presented at the second session of the meeting were on thermal problems, while a third paper, by L. J. Bradford, presented characteristic curves for fluid film lubricated journal bearings.

In the first thermal paper presented the results of research on heat transmission from metal surface to boiling liquid, performed at Pennsylvania State College, were reported by D. C. Cryder and E. R. Gilliland. The authors described the apparatus used in determining the heat transfer coefficient from a heated brass pipe to various boiling liquids. The heat transfer rates were determined for 11 different solutions, including water, methanol, carbon tetrachloride, normal butyl alcohol, glycerol solution, gasoline, kerosene, two sodium chloride solutions and one solution of sodium sulphate. When the heat transfer rates were plotted against temperature difference, it was found that a separate curve was obtained for each of the liquids, and that all of these were straight lines on logarithmic paper having a slope of 2.4.

By taking into consideration such factors as specific heat, specific gravity, surface tension, viscosity, latent heat of the various liquids tested, together with the diameter of the hot tube, it was possible to correlate the results on all liquids, so that they fell very closely on a single straight line.

The authors cautioned against using the equations developed for application to any other condition than that existing in the test set-up.

The second thermal paper presented had to do with the surface absorption of heat from solar radiation, and was presented by F. G. Hechler which information is of interest to air conditioning engineers.

For a given intensity of radiation and angle of incidence, the surface temperature will depend on (a) the color and nature of the exposed surface, (b) the wind velocity across the surface, (c) temperature of air and surrounding objects, (d) the heat capacity of the structure, and (e) the thermal resistance of the structure.

The paper gave results of an experimental study of the effects of color, and of the nature and arrangement of surfaces and materials on surface temperatures, and on the heat flow through horizontal surfaces exposed to sun radiation.

Solar Radiation Absorption

It was found that metallic paints absorbed more solar radiation than non-metallic paints. For non-metallic paints, white is the best color for preventing the absorption of solar radiation. The order of other colors tested is, red, green and black. Weathering and the accumulation of dirt decreases the relative value of white and other light colors. Aluminum paint is not as good as aluminum foil in retarding absorption of solar radiation. Both are more effective when applied to an inner surface facing an air space, rather than on a surface exposed to the sun, and white non-metallic paint was found to be slightly better than aluminum foil. For air velocities greater than about 10 miles an hour, the importance of surface color decreases.

In the discussion of the paper the question was raised as to the effect of the thermal capacity of the structure on the heat transmission and the time lag between maximum outside surface temperature and the heat flow into the room.

Third Session

The three papers at the third session were, "The Destiny of Engineering," by Ralph E. Flanders, the student prize paper by E. M. Barber, the subject of which was, "The Handling of Bearing Performance Data by Correlation with the Hydrodynamic Theory of Lubrication," and a paper on "Cold Diffusion in Commercial Application" by H. Harrison.

Fourth Session

At the fourth technical session the problems particular to various types of refrigerating plants were the subject of discussion. Fred Ophuls presented a paper on refrigeration in breweries. In this paper the various steps in the process of brewing beer were briefly related, and the refrigeration requirements of the various parts of the process were outlined. The principal refrigerating loads were cooling the liquor from the temperature of the city water to 45 deg., absorbing the heat of fermentation and maintaining the beer at 34 deg. in the beer aging or storage room.

In the discussion of the paper it was suggested that cooling the beer by vacuum produced by steam jets might prove to be economical. It was also pointed out that before prohibition there were 1,200 breweries in the country, and that there now were only about 131, and that before prohibition the consumption of beer was 66 million barrels, but now it had dropped to 5 million barrels of near beer.

A paper by W. E. Zieber and J. C. Consley presented data showing the seasonal variation in refrigeration requirements for various food products in storage and warehouses.

A paper by A. B. Stickney compared six cycles for producing solid CO_2 as to efficiency and power requirements per ton of solid CO_2 obtained. All of the cycles compared involved three stages of compression. In the first or simple cycle the gas was expanded directly from condenser pressure into the snow chamber. The precooling cycle makes use of the cold gas from the snow chamber to cool the liquid CO_2 before expansion which increases the yield of solid CO_2. In the bleeder cycle, liquid from the condenser was expanded in three stages, and the gas developed at each stage returned to intermediate stages in the compression. Two other cycles compared included the combination of bleeding and pre-cooling, together with pressure snow-making cycle. The sixth cycle involved the use of ammonia for the liquefying of the compressed CO_2 gas.

The results showed that with the binary ammonia cycle efficiencies referred to the Rankine cycle of 72 per cent were attainable, indicating a theoretical power consumption per ton of carbon dioxide of slightly over 120 kw.-hr.

In the discussion following the presentation of the paper, Mr. Everett asked whether it would be possible to use an inert gas in the third stage of the CO_2 compression in order to improve efficiency. The author, however, was of the opinion that this would not help. Mr. Jones pointed out that increasing leakage of CO_2 at higher pressures would materially affect the optimum head pressure of the system. The author agreed with him, and pointed out that all of the data presented in his paper was based entirely on theoretical thermodynamics of the cycle and did not consider the performance of practical equipment.

At the last session of the meeting an interesting paper, "Ebullition of Refrigerants," by L. A. Phillipp and Mr. Tiffany was presented. This paper gave the results of an investigation into the cause of the erratic behavior of cross-over evaporator tubes in a flooded system in which a mixture of SO_2 and oil was used as the refrigerant.

It had been observed that on various occasions certain of these tubes failed to frost-over indicating the absence of any appreciable refrigerating effect. Investigation disclosed that it was possible to superheat the SO_2 and oil refrigerant as much as 60 deg. With pressures calling for a normal evaporation at 14 deg. this meant that at room temperatures the refrigerant was not boiling and consequently no refrigeration took place.

A search was made for a catalyst that would prevent or decrease the superheating of the liquid. Of the various materials tried wood was found to be the best. It reduced the liquid superheat to 3 deg.

The superheating of the refrigerant liquid was explained by a consideration of the theory of surface tension, equations for which were developed in the paper. This study showed that the best catalyst was one whose surface would not be wetted by the refrigerant.

In the discussion it was brought out that ground cocoanut had been tried as a catalyst for this purpose but that its action wore off. The author replied that he used maple, walnut and rattan and that these retained their catalytic properties.

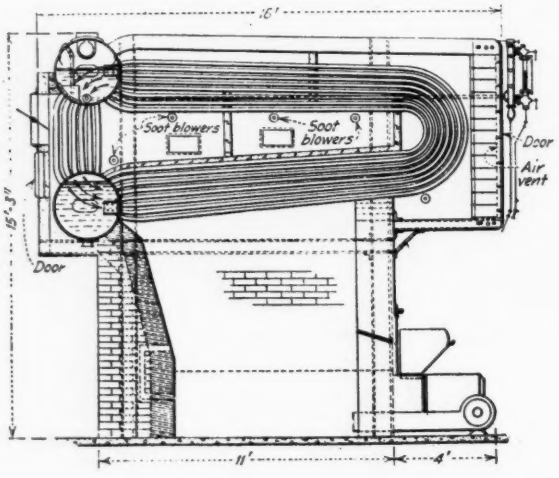
REVIEW OF
POWER and MECHANICAL EQUIPMENT

● In the pages that follow *Power* presents its fifth annual review of new and improved equipment.

● Previous reviews were published in February of each year. This year the issuance of a special Mid-December number reporting the National Power Show, the Annual Meeting of the A.S.M.E. and the Annual Meeting of the American Society of Refrigerating Engineers provides an ideal setting for a number summarizing power equipment development.

● The descriptions here presented are principally those which have appeared in *Power* since February, 1932. This itemized summary of the year's equipment progress in the power field proves that 1932 has not been without its good fruits. The reader will find here a most impressive display of equipment designed to do a better power job at lower cost.

Boilers, Refractories and Accessories



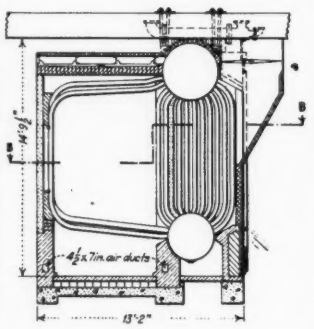
New Low-Head Boiler

Two-drum and three-drum models of Burton boiler now available, two-drum design being illustrated. Due to design, boilers may be installed with extremely low headroom. Both are of bent-type type, two-drum type being used particularly for direct-fired steam or hot-water heating. Reduction of drums to two results in lowered cost. Three-drum type, built in units from 200 to 600 hp. and for pressures up to 600 lb., is designed especially for a rapid steaming unit for industrial plant installation.

Lasker Boiler & Engineering Corp., 3201 S. Lincoln St., Chicago, Ill.

Low-Head Steam Generator

This radically new type of low-head bent tube boiler, "S&G steam generator," is designed primarily to burn pulverized coal, oil or natural gas, and is suitable for capacities from 15,000 to 100,000 lb. of steam per hour, for any desired pressure. Introduction of a bridge wall across furnace and modification of radiant surface forward of bridge wall makes design readily adaptable to stoker firing. Boiler is of two-drum type, but drums are placed parallel to furnace and at one side of it.

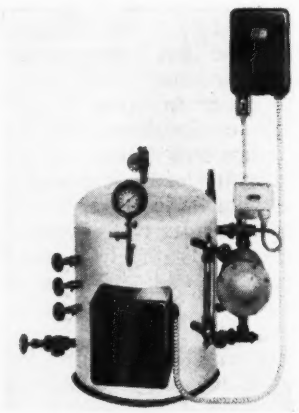


A double row of tubes completely encircles furnace, thus greatly increasing radiant heating surface. Permits greater capacity under limitations of low headroom, provides increased radiant surface without waterwalls, and provides an adequate furnace and great length of gas travel.

Freeman Boiler & Engineering Co., 222 West Adams St., Chicago, Ill.

Electric-Heated Steam Boiler

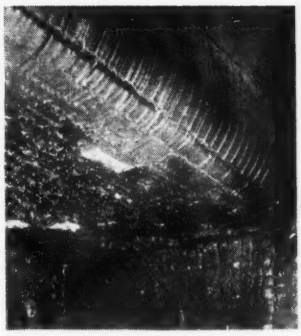
"Comm-O-Lectric" electric-heated full-automatic steam generators for producing process steam in small or moderate quantities and at pressures from 1 to 200 lb. gage are available in six standardized models, 7½, 15, 30, 45, 60 and 90 kw. They conform to all requirements of A.S.M.E. Boiler Code. One- to 6-kw. units also available.



Commonwealth Electric & Mfg. Co., 105 Boston St., Boston, Mass.

Fire Brick

Laclede Mullite refractories are crystalline combinations of silica and alumina. Resist spalling. Withstand very high temperatures without shrinking or deforming, and resist attack from molten slag. Also has high load bearing capacity, and due to its high refractoriness, its fusion point is cone 34. A special Mullite base cement, Setskold 7, has been developed for use with the brick. It is an air-setting mortar, available in



100, 200 and 500-lb. metal drums. Chrome mortar with air drying properties available also in 150-lb. drums. Illustrated is arch in a furnace.

Laclede-Christy Clay Products Co., St. Louis, Mo.

Superheaters for H.R.T. Boilers

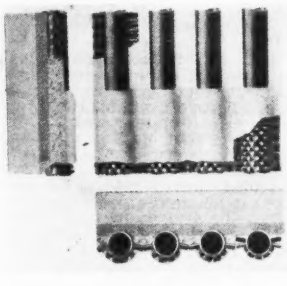
Superheater units of heavy-gage steel tubing, cast-steel headers, and cast-steel safety valve, all supported from main boiler shell, form "Elesco" superheater for H.R.T. boilers. Saturated-steam header (right-

hand side) connected to superheated-steam header by units secured by detachable clamped joints. Safety valve nozzle extends upward at left. Steam temperature control attained by adjustment of supports regulating distance of units from boiler shell.

The Superheater Co., 60 East 42nd St., New York, N. Y.

Stud-Tube Type Water-Cooled Furnace Wall

Bailey stud-tube furnace wall construction is designed to supplement present Bailey wall

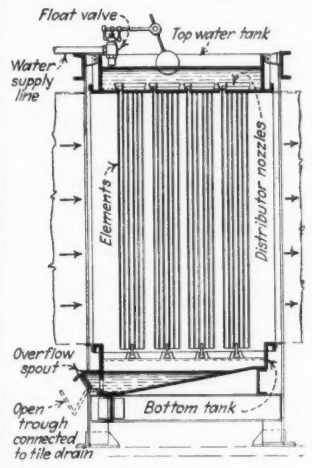


constructions with a water-cooled wall. Lower portion of wall coated for use in hotter portions of furnace. Wall construction consists of water-cooling tubes spaced as usual with iron studs welded to tubes and plastered over with refractory of suitable conductivity and thickness. Upper portion of wall (shown in section) leaves tubes exposed for more rapid heat absorption without interfering with efficiency.

Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.

Flue Gas Scrubber

Riley scrubber consists of series of ribbed baffle plates placed vertically between two tanks. Gases to be cleaned zig-

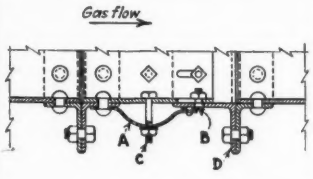


zag through scrubber horizontally, impinging against faces of baffle plates placed at angle to flow. Plate surfaces covered with water which carries dust and soluble gases down and out. Evaporation claimed less than 4 per cent.

Riley Stoker Corp., Worcester, Mass.

Expansion Joint for Flues and Ducts

This joint allows expansion and contraction of flue without rupture or distortion of metal of joint. Made complete in shop and bolted or riveted to flue in field. Applicable to rectangular, irregular or round flue sections.



Expansion taken care of by asbestos lining *B* riveted to spring-clip *A*, held down by bolt *C* sliding on an angle *D*, with which asbestos lining *B* is always in contact. No distortion in spring clips, for expansion is allowed by movement of lining *B* on angle *D*.

Bergen Point Iron Works, Bayonne, N. J.

Smoke-Density Meter

This meter measures density of smoke in flue gases by optical means, a portion of gas passing between light source and photo-electric cell. Chart of instrument calibrated to read

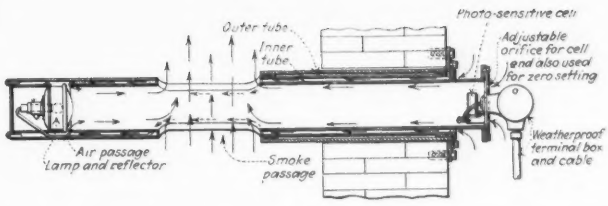
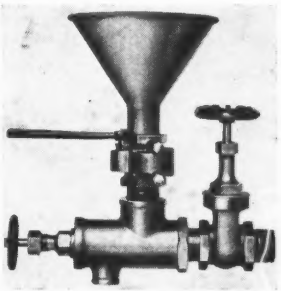


Photo-sensitive cell
Outer tube
Inner tube
Adjustable orifice for cell and also used for zero setting
Air passage Lamp and reflector
Smoke passage
Weatherproof terminal box and cable

in per cent of smoke density, scale being readable either in per cent or in terms of Ringelmann scale. Preferred arrangement illustrated has advantage of requiring only one hole in stack or uptake. Sampling tube construction prevents soot or smoke accumulation on lamp or on light-sensitive device. Withstands up to 600 deg. F.

Brown Instrument Co., Philadelphia, Pa.



Condenser-Injector

"Wizard" condenser-injectors inject special sealing mixture into circulating water, claimed to stop leaks within five minutes. Sealing mixture claimed inexpensive and harmless. Recommended for use with salt detector light available from same maker.

Condenser Service & Engineering Co., 310 Twelfth St., Hoboken, N. J.

Baffle Material

"Enco" plastic is special mixture of refractories that sets cold; unaffected by temperature changes found in boiler work. Will not spall nor be injured by moisture from use of soot blowers or in washing boilers.

The Engineer Co., 17 Battery Place, New York, N. Y.

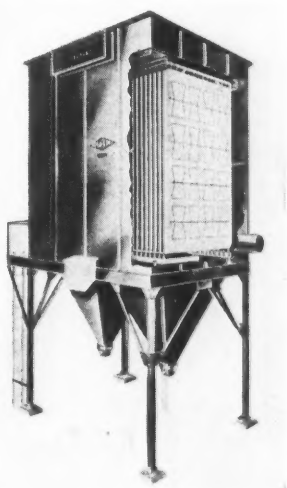
Smoke Indicator

"Bell - Lite" photo - electric smoke indicators ring a bell and flash a light when smoke issues from boiler or stack, thus giving a visible and an audible signal simultaneously. Chart recorder may be attached readily.

Parry Engineering Co., 135 E. 42d St., New York, N. Y.

Framed-Bag Dust Collectors

Cloth filters are used in Blaw-Knox all-metal dust collectors. Simple wrapping type cloth bag seal uses only two bolts. Minimum supplementary equipment



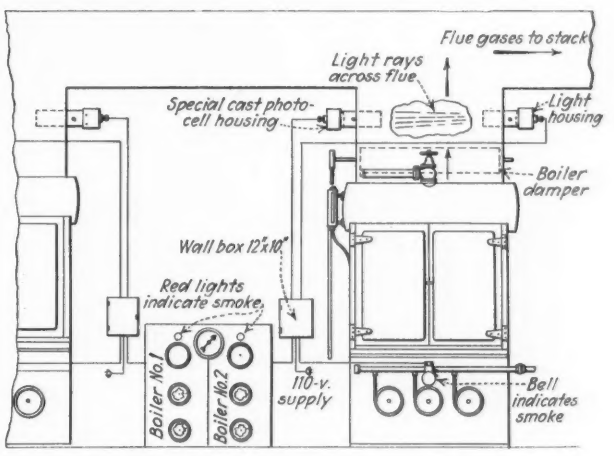
required, also lower weight per unit of capacity, special cleaning, accessibility, low erection cost, compactness and positive action. Engineering service on dust collector problems.

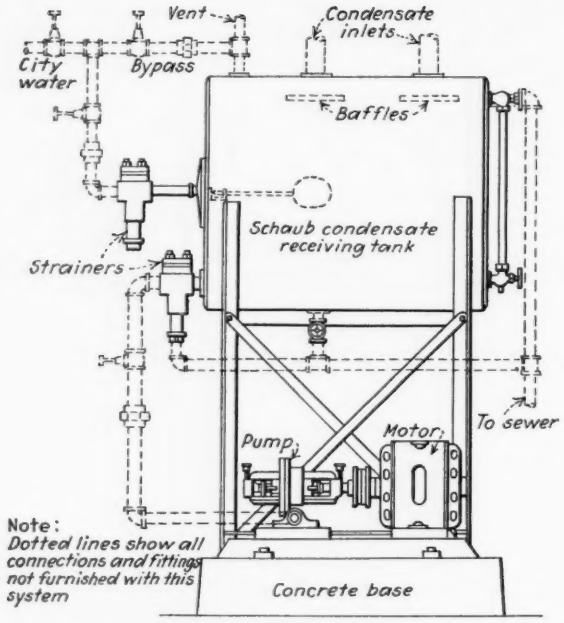
Blaw-Knox Co., Pittsburgh.

Vertical Baffle Partition

Interlocking tiles form this partition, applicable to boilers with vertical tubes. Tile sections have tongue and groove horizontal joints, lap vertical joints.

Power Plant Efficiency Co., 155 East Market St., Indianapolis, Ind.





Boiler Return System

The "Schaub" boiler return system performs three operations automatically: Returns high- and low-pressure condensation, supplies make-up water to the boiler, maintains uniform water level in boiler. Incorporates special No. 332 automatic valve. Unit available in all sizes from 1 to 300 hp., for all working pressures from 5 to 150 lb. Larger sizes and higher working pressures also.

Fred H. Schaub Engineering Co., 325 W. Huron St., Chicago, Ill.

Refractory

"Cast-Refract" can be cast or molded on the job to any desired shape or form. Air-sets quickly with high structural strength, and can be put under full heat within 24 hr. Shipped dry. Produces monolithic structure air-and-gas-tight, free from shrinkage, highly resistant to spalling, and with refractory properties up to its temperature limit 2,600 to 2,800 deg. F.

Quigley Co., Inc., 56 West 45th St., New York, N. Y.

Welded Fire-Tube Boilers

Welded fire-tube boilers for high pressures and high ratings eliminate girth seam and fire crack difficulties. All boilers electric welded, and physical tests made of welded coupons attached to each end of longitudinal seams of all boilers. All seams X-rayed and boilers are stress-relieved in large furnace to eliminate internal stresses. Thus the boilers meet A.S.M.E. code and are insurable.

Hedges - Walsh - Weidner Co., Chattanooga, Tenn.

Heat Reflection Brick

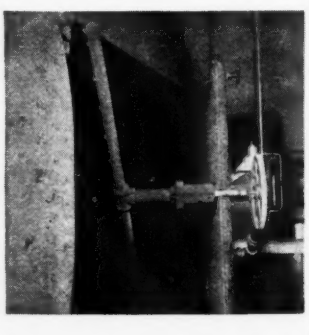
EF brick, designed for direct exposure and heat reflection, allows quick heating and eliminates heat storage. Adaptable for flat arch construction, and has sufficient strength for structural purposes. Comes in machine sizes but may be made in special large sizes and shapes.

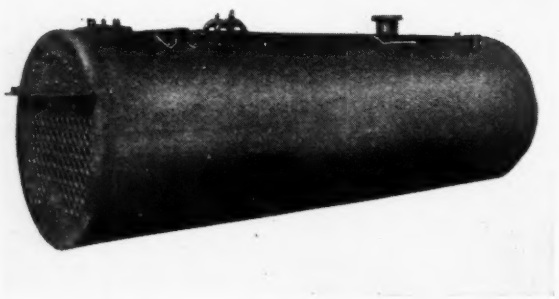
Armstrong Cork & Insulation Co., Lancaster, Pa.

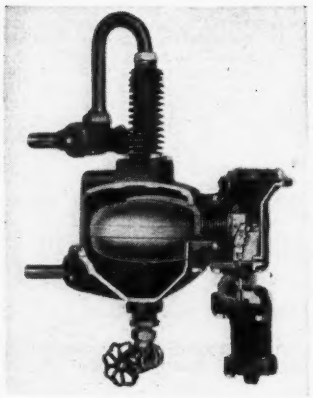
Soot Blower System

"Diamond" Air-Puff Soot Blower Systems are available for fire-tube and water-tube boilers. Fire tube, known as "A-1," is shown. A-2 System for water-tube units.

Diamond Power Specialty Corp., Detroit, Mich.



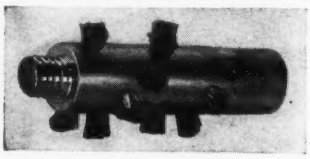




Water Feeder for Small Boilers

No. 37 "Safety" water feeder for boilers under 2,500-ft. capacity, follows company's line of 30 series heaters, and also has quick hook-up features. Quick hook-up is accomplished by screwing brass nipple at left into body of feeder, and adjustable goose-neck equipped with union and brass nipple for top connection. Unit is installed by inserting in gage glass position in boiler. Feature is a cool feed valve operating below 114 deg.

McDonnell & Miller, Wrigley Building, Chicago, Ill.

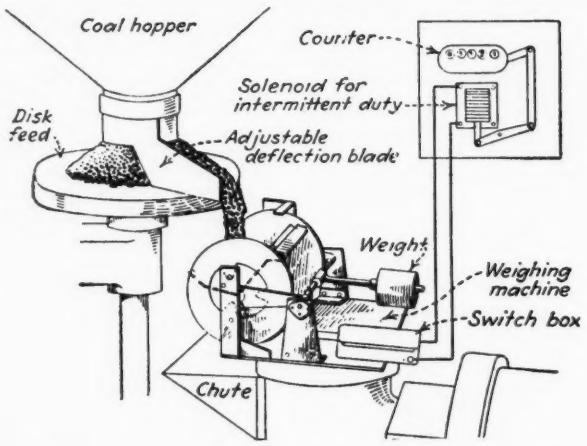


Tube-Cleaning Brush

"Tubrush" tube-cleaning brushes have 18 tufts of bristles, each containing 133 wires of heat-treated steel, laid and crimped, and presenting 2,400 cutting edges. Bristles are self-centering and are straightline type, not bent or sewed. Can be renewed at factory. Made from ½-in. up to fit flexible-shaft equipment, and for hand punching. Reversible end cap.

Vroom Rotary Packing Corp., 755 South St., Waltham, Mass.

Coal & Ash Handling Equipment



Coal Weigher with Electric Counter

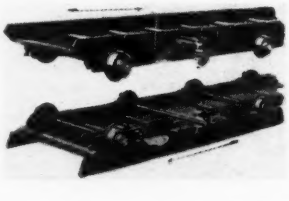
This device for weighing coal fed to hopper of pulverizer occupies low headroom. Details of weighing unit are shown. It consists of revolving container or bucket having three pockets rotating on horizontal spindle, a counterweight, a solenoid and a counter. Four sizes of weighing units have been developed and are now available, capable of delivering from 1,000 to 7,000 lb. of coal an hour.

American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa.

Steel Apron Conveyor

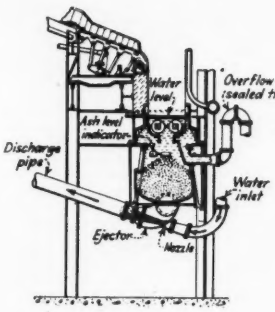
"Gravity Seal" steel apron conveyor has a new method of attaching conveyor pans to chains by means of patented pivoted links. This link, in connection with several constructional elements, causes pans to overlap, in order to eliminate leakage of material and yet provide sufficient flexibility to enable conveyor to travel without strain evenly around sprockets. Crossrods, mounted through center of chain links, are fitted with housing bushings. All roller parts may be replaced easily. Each pair of rollers carries load of two full pan pitches on both carrying and return run of conveyor.

Webster & Weller Mfg. Co., Chicago, Ill.



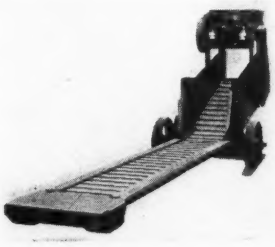
Hydraulic Ash Evacuator

This ash-disposal system permits reduction of usual power plant basement depth to one-half. Entire system closed, and ashes are under water until they are shot out of discharge pipe. Submerged clinker-grinding rolls below furnace crush ash and sink it into a dump or ash pit of concrete or cast iron. High-velocity water jet in an ejector nozzle sweeps ashes and water through a pipe line at intervals. Entire operation can



be made automatic, and 4 to 5 tons of ashes a minute can be removed by a relatively small amount of water at 100-125 lb. pressure. Typical arrangement of evacuator shown.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Portable Troughed-Belt Conveyor

Lengths of 20, 25 and 30 ft.; handles small sizes of coal. 48-in. carriage wheels mounted on roller bearings. Conveyor belt rubber, 18 in. wide running on roller bearing idlers equipped with pressure grease fittings. Steel plate receiving hopper at foot with rubber wear strips; steel skirt plates form trough 6 in. deep. Discharge height adjustable. 3-hp. motor or 4½-hp. gasoline engine required for roller chain drive. Feeder of same company illustrated.

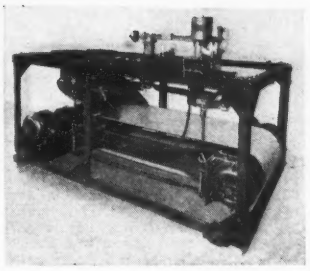
Fairfield Engineering Co., Marion, Ohio.

Portable Conveyor

Incorporates fixed steel retaining sides extending entire length of conveyor. Foot end improved to keep material away from return run of conveyor belt. New arrangement of foot

end plate permits use without plate when desired. Twenty-one foot centers with 18- or 24-in. belts. Idlers all-metal troughing type with anti-friction roller bearings.

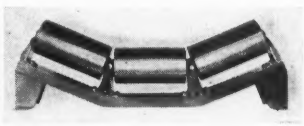
Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill.



Conveyor Scale With Photo-Electric Unit

Using light-sensitive cell as means of totalizing weight of materials transported is a feature of Telepoise feeder and conveyor scales. Unit illustrated designed to control coal feed to stokers and at same time to weigh it. Positive automatic control can be furnished.

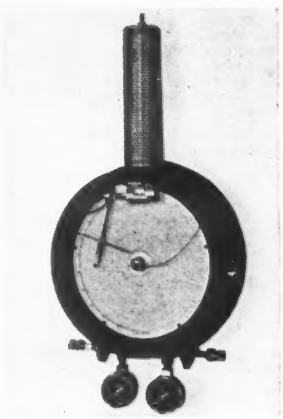
John Chatillon & Sons, 85 Cliff St., New York, N. Y.



Anti-Friction Conveyor Carrier

Interchangeable Shafer roller bearings of self-aligning type are used to take thrust and radial load in these carriers. Can be interchanged with any standard carriers. Carrying capacity of carrier 600 lb.

Barber-Greene Co., Aurora, Ill.

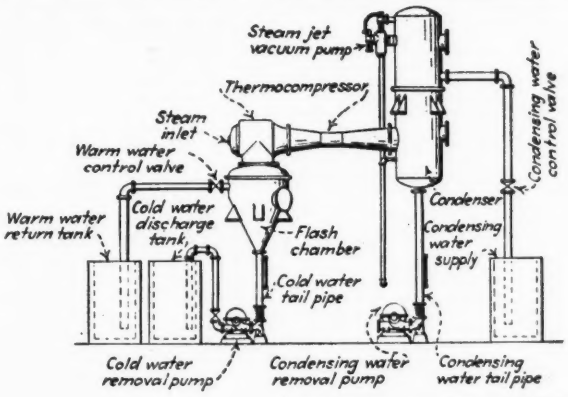


Relative Humidity Recorder

Relative humidity can be read directly, without calculation, from recorder. Simple and durable, especially for air conditioning service. Portable, entirely self-contained. Employs specially developed membrane calibrated so that relative humidity is recorded directly in per cent. Ten-inch case, seven-day or 24-hr. clock movement. Humidity controller (shown) also available, which maintains humidity by automatically controlling spray heads either through an air or water valve.

Foxboro Co., Foxboro, Mass.

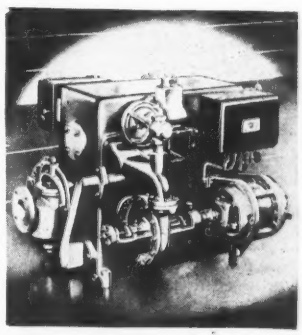
Heating, Ventilating, Refrigerating Equipment



Pump for Vacuum Heating Systems

For vacuum heating systems, Jennings vacuum pump is driven by a vapor turbine taking steam from the main heating line, exhausting it back to heating system and operating on 2½-lb. pressure differential. Incorporated is complete electrically-operated standby unit with full automatic control. With this arrangement capacity of both pumps can be utilized under peak load conditions, as electrically-driven unit will automatically cut in at any time when steam supply is insufficient to operate turbine. An installation is made in combination with a vapor turbine valve, which constantly maintains a pressure differential of 2½ lb. between the inlet and exhaust of the turbine.

Nash Engineering Co., 166 Wilson Rd., South Norwalk, Conn.



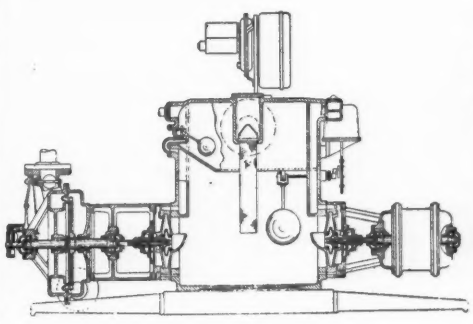
Vacuum Pumps

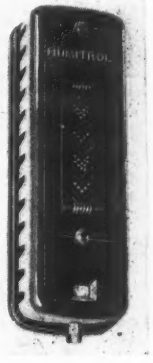
Hoffman-Economy vacuum pumps and condensation pumps are simplified and improved in appearance. Now employ rectangular receivers of cast iron. Motors standard make to permit quick replacement. All pump parts readily accessible.

Economy Pumping Machinery Co., 2431 W. 48th Place, Chicago, Ill.

Humidity Control

"Humitrol" closely controls operation of any equipment which may either add or withdraw moisture from air. Appli-

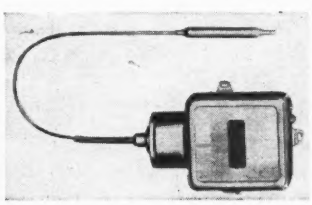




Water Cooled by Vacuum Refrigeration

To supply cooling water at temperatures of 32 to 50 deg. for industry and air-conditioning systems, this vacuum refrigeration system operates on principle of flash evaporation. Water to be cooled is piped into a high-vacuum chamber. If water temperature is above that corresponding to saturation temperature for chamber vacuum, evaporation will occur. Vapor liberated from the body of water absorbs latent heat of vaporization from water introduced into flash chamber. This removal of heat cools remaining water to a temperature corresponding to absolute pressure in flash chamber.

Foster Wheeler Corp., 165 Broadway, New York, N. Y.



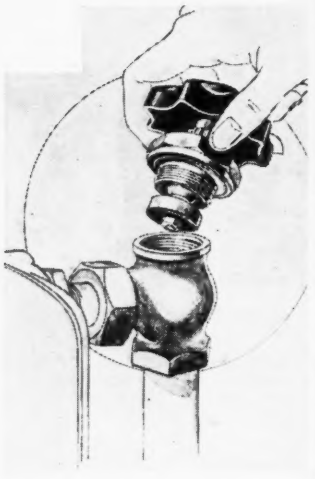
Refrigeration Temperature Control

Type 414-1 is suitable for commercial installations, either air temperature, brine or liquid systems. Control has visible scales with locking provision. Bulb-type unit designed to provide remote control where it is not practical to place a thermostat.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

cation comparable to a thermostat in that hygroscopic, ribbon-type element expands or contracts as moisture content of air varies, and action is multiplied by a lever mechanism used to operate mercury tube switch.

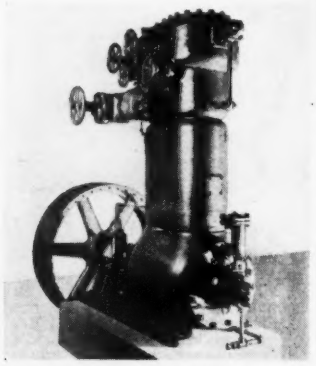
Lewis Air Conditioners, Inc., Minneapolis, Minn.



Valve Bonnet Replacement Assembly

Type R bonnet assembly is a replacement unit designed to modernize any size or standard make of packed or packless inlet valve. Assembly is of quick-opening high-lift construction.

Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, Ill.



Ammonia Booster Compressor

Semi-inclosed, vertical and single-acting booster compressors designed for use in plants where special low temperatures are required. Will reach —20 to —50 deg. F. Used to boost or raise the pressure of a gas from a low-temperature evaporator to pressure level of another evaporating system handling a higher temperature load and connected to an independently controlled compressor. Can be furnished in either simplex or duplex drive styles arranged for mounting motor direct on a compressor shaft, or with a V-belt adjustable-center drive.

York Ice Machinery Corp., York, Pa.

Convector Cooling Unit

These overhead-type convector coolers have adjustable louvers in the housing to control elevation of air leaving the unit

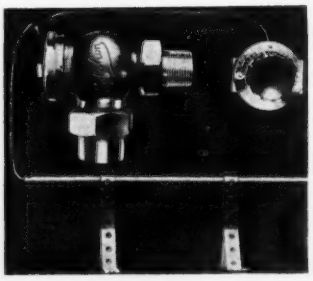
and avoid drafts. Suspended from ceiling or wall, they can be used with ice, mechanical refrigeration or tap water. Construction consists of an outer shell insulated from chassis frame by cork, a radiator core and fan and motor rubber mounted. Convector, with entering air at 80 deg. and 60 per cent relative humidity and 40-deg. water, has cooling capacity of about 120 lb. ice melted per hour at medium fan speed. Capacity adjustable.

McCord Radiator & Mfg., Co., Detroit, Mich.

Cork Covering

This improved-type cork covering for cold pipes is 11 per cent more efficient than present standard cork covering because of lower density achieved by a new process of manufacture which knits cork granules more closely together.

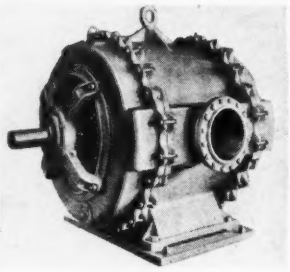
Armstrong Cork & Insulation Co., Lancaster, Pa.



Thermostatic Radiator Valves

"Sylphon" automatic radiator valves are: No. 885 for exposed, in angle type, and No. 886 in globe; No. 895 angle for inclosed and No. 896 for globe. Valves require no piping, wiring or auxiliary equipment. Temperature variation between 60 and 90 deg. controlled in exposed type, and 40 to 90 deg. F. in inclosed.

Fulton Sylphon Co., Knoxville, Tenn.



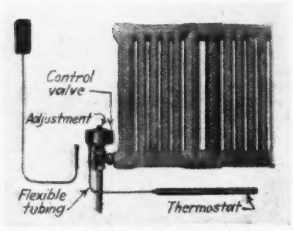
Vacuum Pump and Compressor

Nash cone-type "Hytor" vacuum pump and compressor has pump with but one moving part. New design for higher rotating speeds shows increased vacuum, pressure and efficiency. Incorporates cone within rotor hub containing two inlet and two outlet ports. Design claimed to permit freer passage of air in and out of rotor buckets and more nearly straight-line flow of air through pump. Pump will maintain vacuum up to 28 in. mercury and pressures up to 35 lb. per sq.in.

Nash Engineering Co., 166 Wilson Rd., South Norwalk, Conn.

Thermostatic Radiator Valve for Steam Heating System

Employing same principle as Powers standard regulators, new thermostatic radiator valve is for direct, indirect or concealed radiation of vapor vacuum heating system. Has sensitive thermostat outside radiant-heat zone of radiator and does not operate on a radiator temperature differential as in many designs. Valve control is diaphragm-operated, connected by armored flexible



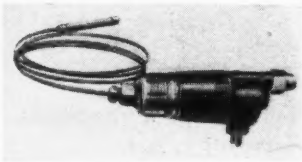
tubing to thermostat in either of two styles: one encased with thermometer for wall mounting, other a tubular-shaped element for use with concealed radiation, unit heaters and wall type radiators. Sizes from ⅜ to 2 in.

Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.

Sealed Corkboard

Super-service corkboard for cold storage rooms is coated on both faces at the factory with a special mastic compound applied mechanically under pressure. It is said to possess 15 per cent greater insulating efficiency than standard corkboard.

Armstrong Cork & Insulation Co., Lancaster, Pa.

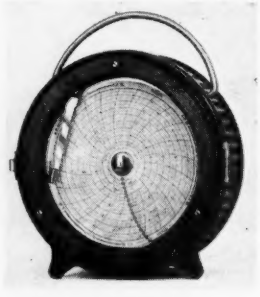


Thermostatic Expansion Valve

Detroit No. 673 thermostatic expansion valve, successor to No. 671 American unit, extends the application of the dry evaporator to multiple systems. Furnished standard with 0.078-in. orifice diameter, but on special order with 0.125 or 0.156. 0.078 orifice has a capacity of two tons of methyl chloride and one ton SO_2 or F-12.

Detroit Lubricator Co., Detroit, Mich.

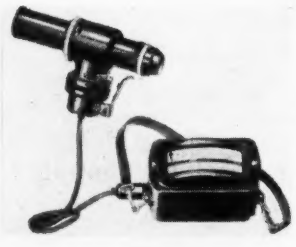
Meters, Recorders and Testing Instruments



Direct-Reading Relative Humidity Recorder

"Humidigraph" avoids reference to tables and calculations by providing direct reading. Hygroscopic measuring and actuating element consists of sensitive wood fibers built up on nickel wire screen and wound in spiral form. Relative humidity changes cause angular rotation of free end of element, actuating penarm linkage. Available in round-case models using 4 or 8-in. charts, in portable or surface-mounting types. Combination instrument with two pens marking on same chart, one showing humidity, other temperature, may be obtained. Case corrosion-resistant.

The Bristol Co., Waterbury, Conn.



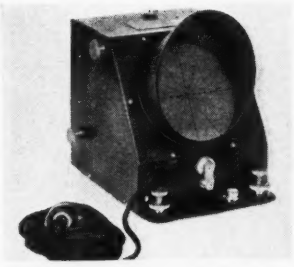
Optical Pyrometer

"H-K" optical pyrometers, Holborn-Kurlbaum type, furnished with three-range telescope for measuring temperatures up to 2,600, 3,700 and 5,500 deg. F. Direct-reading scale with two ranges, 1,100-2,600 and 2,200-3,700 deg. F. Conversion table supplied for third range. Weighs 5 lb. and is 6x6x3 in. Teleobjective attached for observing small objects at great distance.

Bacharach Industrial Instrument Co., 7000-6 Bennett St., Homewood Station, Pittsburgh.

Vibration Measuring Instrument

Model S2-Davey Vibrometer is capable of measuring horizontal and vertical vibration simultaneously. Instrument is simply laid on object whose vibrations are to be measured, and a spot of light traces out the exact path of vibration magnified many times on ground glass scale. Will measure frequency and phase position in addition to amplitude, if used in conjunction with Davey portable

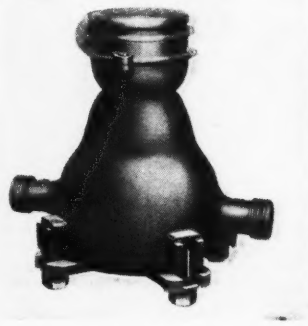


balancing equipment. Instrument will indicate accurately amplitudes of vibration for frequencies above 400 per min., and up to approximately 6,000 per min. Available in two sensitivities. S-2A, which magnifies vibration approximately 500 times, and S-2B, magnifying approximately 250 times. Photographic records may be obtained of any repeating vibration.

Electrocon Corp., 6 Varick St., New York, N. Y.

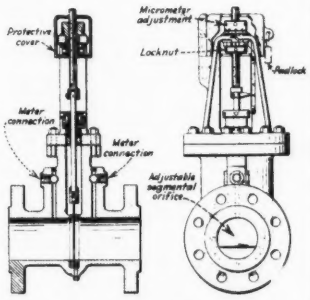
Water Meter

Model GA, built in sizes from ¾ to 2 in., with normal flow limits from 1 to 160 g.p.m. Is of positive-displacement disk type with rubber-bushed reg-



ister gears. Register box fitted with double lid to facilitate cleaning of cover glass. Train assembly comprises four cast bronze gears and four pinions, all on Monel metal spindles.

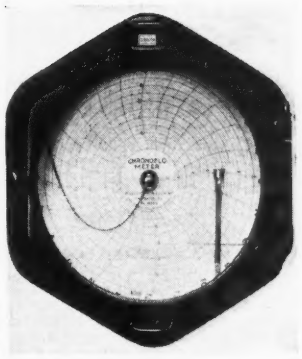
Worthington Pump & Machinery Corp., Harrison, N. J.



Adjustable Orifice for Fluid Meter Installations

For fluid meter installations where it is desirable to maintain measurements over a wide range of capacity, this adjustable orifice is particularly suitable. Consists of flanged body with integral meter connections and can be installed readily in steam, water or gas line and connected to any differential-head type of fluid meter. Adjustable orifice functions similarly to fixed type Bailey segmental orifice. Micrometer adjusting screw permits setting height of gate segment within 0.001 in.

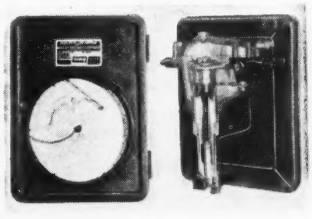
Bailey Meter Co., 1036 Ivanhoe Road, Cleveland, Ohio.



Electric Flow Meter

Wide measuring range, accuracy, and abundance of power are claimed for "Chronoflo" meter. Capable of keeping chart record reliable to 1/12 maximum rate, and total flow register accurate to 1/20 of maximum flow. Used with either Venturi tube or orifice place, and is combination of Telechron motor, mercury switch, power relay and electromagnetic clutch.

Builders Iron Foundry, 9 Codding St., Providence, R. I.



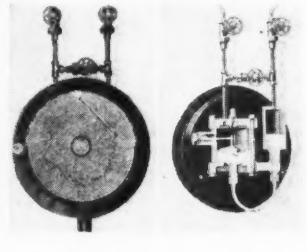
Fluid Meters

Three general combinations of fluid meter: indicating and integrating; recording and integrating; indicating, recording, and integrating. Illustrated is the recording and integrating fluid meter (best suited to the majority of installations). Record in lb. per hr., gal. per min., or any other desired units on a 12-in. diam., 24-hr. chart. Sectional view shows flow mechanism operated by difference in pressure produced between inlet and outlet side of orifice or other primary element inserted in pipe line. No moving parts which require oiling or greasing. Synchronous motor drive for clock.

Bailey Meter Co., 1036 Ivanhoe Road, Cleveland, Ohio.

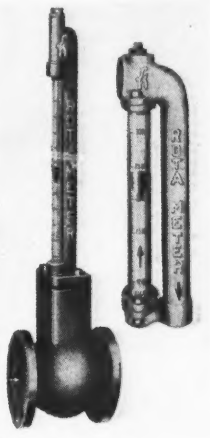
Mechanical Flow Meters

Simple direct lever-actuating mechanism, large float, and pressure-tight bearing with grease reservoir, series of range tubes that permit changing range of meter without disturbing orifice and ease of cleaning manometer without altering calibration are features. Instrument mechanism built into diecast aluminum case. Records on a square root chart or an evenly divided chart. All



models use 12-in. charts. Either hand wound or electric chart drive and variety of chart speeds. Some models incorporate automatic recording planimeters and totalizers. Control models in both single and duplex forms have been developed. Working pressures up to 1,000 lb.

Brown Instrument Co., 4496 Wayne Ave., Philadelphia, Pa.



Indicating Meters for Liquids and Gases

Orifice and through-flow types of "Rotameters," illustrated, are designed to indicate rate of flow in pipe line. Give direct readings in cubic feet, pounds, gallons or other units per hour or per minute. Operating principle is a free, top-shaped float held in suspension by upward flow in a vertical transparent tube, float position indicating actual rate of flow and readings being taken from a scale on float tube. Orifice type at left is designed for large horizontal pipe lines. Through-flow type at right for small and medium-size pipe lines, and has screwed connections in sizes up to 3 in. Units in bronze, aluminum, iron, lead and other metals.

Schutte & Koerting Co., 1165 Thompson St., Philadelphia, Pa.

Improved Concentration Hydrometer

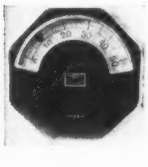
For determining total dissolved solids in boiler waters, this concentration hydrometer consists of but one float and one tube, all scales being inclosed in the float.

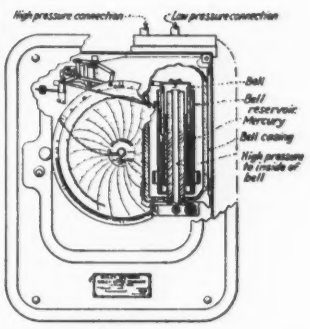
Dearborn Chemical Co., 310 South Michigan Ave., Chicago.

High Water Alarm

Class 9036H1 high water alarm, for use over sump or open tanks, sounds warning when liquid reaches dangerous level. Consists of single-pole pressure switch, transformer and bell, mounted on 1-in. pipe. Rising column of liquid in pipe exerts air pressure on diaphragm of switch, closing contact and ringing bell.

Square D Co., Industrial Controller Division, Milwaukee, Wis.

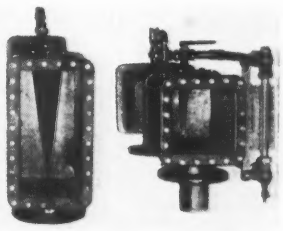




Boiler-Water Level Recorder

Operates on difference in level obtained by making two connections to water column or boiler drum, one to water space, other to steam space, where constant water head is maintained in connection by means of a steam-condensing radiator and reservoir. Recorder may be incorporated with feed-water flow meter to record two related factors on one chart. Remote indicators or recorders operating from main recorder can be placed at other points if desired. Types for all pressures to 1,800 lb.

Bailey Meter Co., 1036 Ivanhoe Road, Cleveland, Ohio.



Weir and Orifice Meters

V-notch weirs and orifice meters in two-body sizes have these ratings: smaller size body takes plates with maximum capacities of 200, 300, 500, 1,000, 1,500 and 2,000 gal. per hr., while larger size has standard plates with maximum capacities of 2,000, 3,000, 4,000 and 5,000 lb. per hr. Plates readily interchangeable. Body is long box or calming section with section of plate glass in front of weir plate. External gage glass provided. Meters furnished regularly in copper, bronze, aluminum, gray iron, Monel metal, nickel, chrome nickel, steel and other non-corrosive materials. Calibration chart supplied with meter.

Vulcan Copper & Supply Co., 120-126 Sycamore St., Cincinnati, Ohio.

Boiler Water Test Meter

Concentration of mineral salts in boiler waters can be tested with this unit, which has built-in thermometer scaled from 60-120 deg. F. Built-in correction table coacts with thermometer; conversion table shows concentration in grains per U. S. gal. and parts per million.

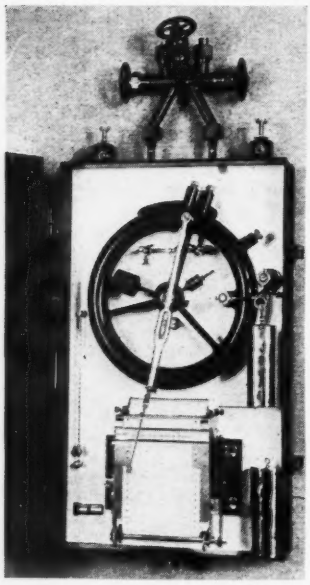
E. Edelmann & Co., 2332 Logan Blvd., Chicago, Ill.

Liquid Flow Meter

"Isometer" consists of actuator located in pipeline, with movements transmitted to meter body. Body in three styles; plain indicating; indicating and integrating, indicating in-

tegrating and chart recording. Line or remote type. Scales graduated in either U. S. gal. per min. or lb. per hr. Actuator units for 125, 250, 400 or 600 lb.

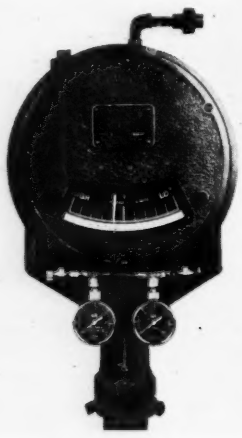
Isometer Co., 2357 North 29th St., Milwaukee, Wis.



Ring-Balance Flow Meters

In principle, actuating mechanism of this ring-balance flow meter consists of a hollow seamless steel-tube ring, with a sealing partition at top to make it a U-tube manometer in principle, filled with mercury or other fluid to a predetermined level and suspended on knife edges at its center of gravity. At top of ring and on either side of dividing partition inlets are connected by flexible pipe to upstream and downstream sides of an orifice plate, venturi or pitot tubes or nozzle located in pipe which carries medium to be measured.

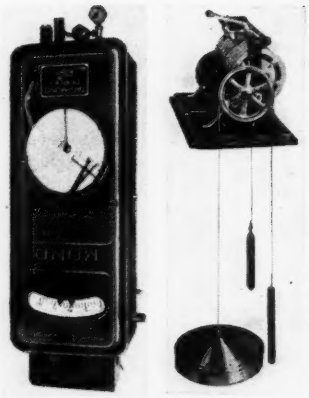
H. A. Bassert & Co., 310 S. Michigan Ave., Chicago, Ill.



Liquid Level Indicator

"Stabilog," designed especially for continuous process industries, is said to prevent surges in flow. Made in two types, throttling and averaging. Combination of Foxboro Stabilog control system and Foxboro differential pressure type liquid level gage.

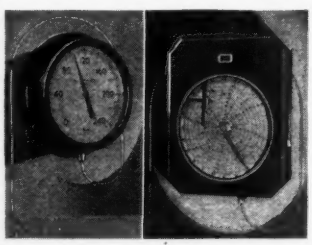
Foxboro Co., Foxboro, Mass.



Automatic Combustion Indicator-Recorder

TAG-Mono all-metal automatic flue gas analyzer not only indicates and records CO_2 per cent, but is designed to give an accurate record of per cent of combustibles which may be present in flue gases. Works on orsat principle, analyzing chemically and indicating and recording electrically. Large illuminated dial; pointers can be seen easily at 30 ft. Records on 9-in., 24-hour circular chart.

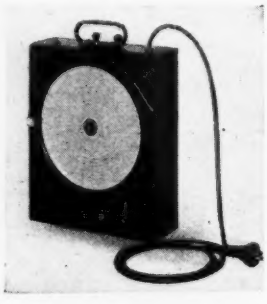
C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.



Rectangular-Case Recording Thermometer

Available in both flush- and surface-mounted styles, new Taylor recording thermometers (right) have cast aluminum cases finished in black with chromium trim. Cases moisture and dust-proof. Mercury, gas or vapor-actuated types are available in this design and also in dial pressure gages and thermometers (left). Heat-treated chromium-plated, alloy steel movements can be obtained if desired for use under vibration. Either face or flush mounting.

Taylor Instrument Companies Rochester, N. Y.



Recording Pyrometer

Type SR portable, electrically driven recording pyrometers weigh 17 lb. Circular chart, 8¼ in. in diameter, driven by self-starting synchronous electric clock movement, provides 24-hr. temperature record.

Hoskins Mfg. Co., Detroit, Mich.

Liquid Level Recorder

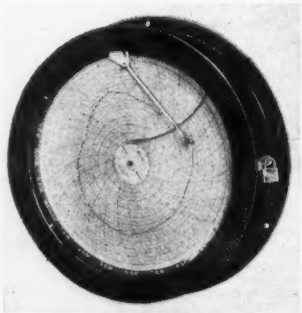
(Left)

Type H "Rational" liquid level recorder of float type. Float travel reduction scales from 1-1 to 1-100. Rate of pencil travel and ratio changeable. Size 8x14½x10¾ in.

Rational Mfg. Co., Redondo Beach, Calif.

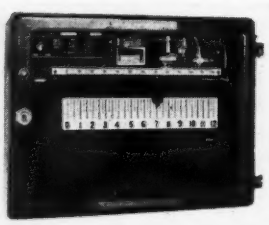
Absolute-Pressure Gage

In determining efficiency of a steam turbine and condenser it is necessary to know amount of back pressure in condenser, which requires measurement of absolute pressure. This abso-



lute-pressure gage does it. Mercury-filled tube with a standard Brown manometer, converted by application of electrical inductance bridge so that it converts changes in relative level of the mercury columns into electrical impulses. Minimum range 0 to 100 mm. of mercury absolute pressure.

Brown Instrument Co., 4496 Wayne Ave., Philadelphia, Pa.



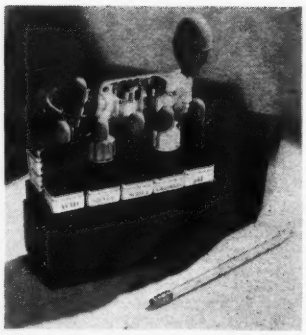
Self-Balancing Indicating Potentiometer

This indicating potentiometer is of self-balancing type, has 40-in. slide wire, positive spiral to shaft drive, non-slip clutch, secondary pointer definitely fixing size of step in moving slidewire contact, interchangeable case for universal mounting, swing-out mechanism for easy inspection, mercury-in-glass switches in control models, automatic thermal equalization between cold junction terminals and compensation coil. As a pyrometer, this instrument can be supplied for any range from 0-103 deg. F., up to 0-3,000 deg. F., or for almost any span between these ranges. Models for automatically controlling as well as indicating temperatures.

Brown Instrument Co., 4496 Wayne Ave., Philadelphia, Pa.

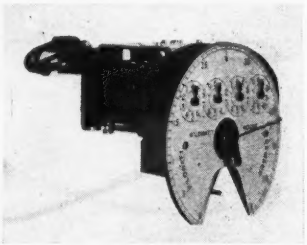
Feedwater Test Kit

This compact kit for rapid testing of boiler feedwater, processing water, bleaching baths, etc., will determine pH values ranging from 3 to 11; hardness to water; and sulphate and chloride content. Kit consists of comparator for making



pH determinations by calorimetric method, pipe and test tube for measuring and holding solution to be examined, funnel, filter paper, necessary indicators and reagents, and instruction book. Reagents in non-leakable, bakelite-top dropper bottles. Eastern representative, Louis H. Joseph, 840 Broadway, New York, N. Y.

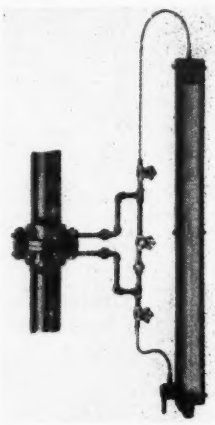
A. Drucker & Co., 1507 E. 55th St., Chicago, Ill.



Watthour Demand Register

Combining regular watt-hour meter register with scale and pointers of an indicating block-interval demand meter, this watt-hour demand register converts standard single- or polyphase OB watt-hour meters into indicating block-interval demand meters. After change, meter will indicate maximum kilowatt demand and integrated kilowatt hours. Known as Type DR attachment.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



High-Range Manometer

Model 391 for checking accuracy of recording flowmeters has steel frame, stainless-steel glands, plate-glass cover, and is tested to 1,000 lb. hydraulic pressure. Mercury, water or Meriman No. 3 fluid with specific gravity of 2.97 may be used. Scale 35 in. long, right side graduated in inches, left

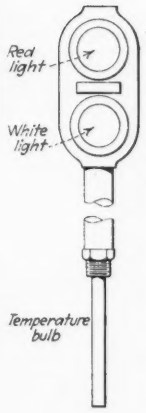
side 0 to 100 in. fluid. Instrument can be used as indicating flowmeter with special equipment available from manufacturer. Standard instrument 42 in. high, 6 in. deep, 4½ in. wide, weighs about 20 lb.

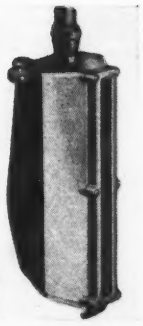
Meriam Co., Cleveland, Ohio.

Electric Temperature Signal

"Thermo-tel" consists of differently colored electric lights actuated by temperature changes, showing low, high or right temperature for any desired setting within one-tenth deg. Can be placed remote from temperature observed; readable at 200 ft.

Uehling Instrument Co., Paterson, N. J.





Water Gage Adapter and Gage Glass Light

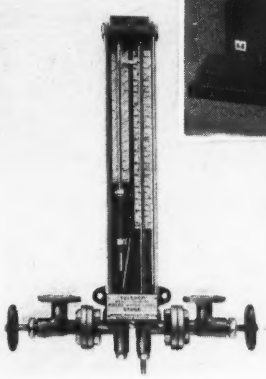
"Incline-A-Gage" is used to change a regulation or vertical water gage into an inclined gage. It has special adapter fittings with self-contained washers ahead of the gaskets to prevent fittings from blowing off. "Gage-Lite" has a two-piece cast aluminum case—light case and door.

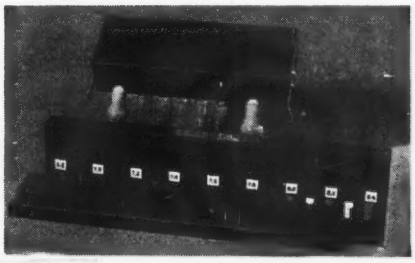
Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland, Ohio.

Boiler Water Level Gage

"Teledep" gages provide remote water level readings at any distance from boiler, gage is operated by water from boiler. Operates cold (claimed to prevent temperature errors and gage glass breakage from excessive heat) uses only two pipe leads and valves, has two scales, water levels shown as readings above or below mean water level.

Dobbie, McInnes & Clyde, Ltd., 57 Bothwell St., Glasgow, Scotland.





Boiler Water Test

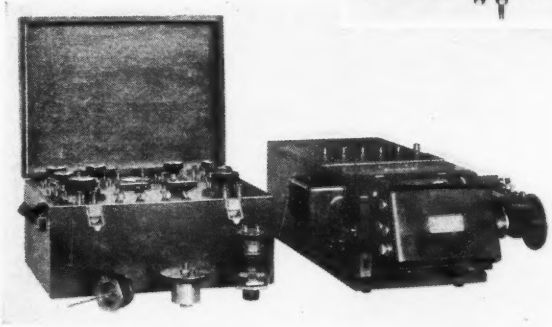
Two outfits for controlling pH and phosphate content of boiler water. Color standards guaranteed for 5 years; pH outfit contains new indicator thymol red; color standard slide contains standards from 8.0-11.2 in intervals of 0.4 pH. Phosphate slide comparator claimed to eliminate errors from silicate, iron, etc. Color standard slide contains standards of 5, 10, 20, 30, 40, 50, 60, 80 and 100 parts per million of phosphate as PO_4.

W. A. Taylor & Co., Inc., 872 Linden Ave., Baltimore, Md.

Recording Absolute Pressure Gage

This direct-reading recording absolute presure gage provides an accurate low-range recorder furnishing record of vacuum automatically corrected for barometric variations and compensated for temperature changes. Simple pipe connection to suction line. Claimed sensitive to slightest changes and accurate over entire scale. Rugged construction. Differential transmitting linkage adds algebraically movements of two sensitive diaphragm elements, one in vacuum line, other affected by barometric pressure variations. Ranges as low as 0-50 millimeters head of mercury pressure absolute or equivalent. Surface or flush mounting.

The Bristol Co., Waterbury, Conn.



Vibration Measurer

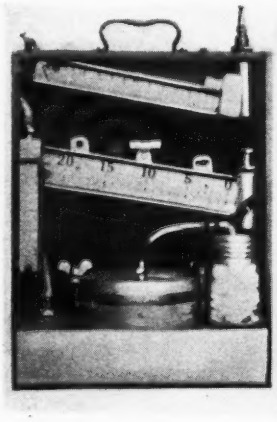
This instrument measures thousandths of an inch vibrations in steam turbines or other machinery. In principle somewhat similar is pressure detector which has small case inclosing one magnetic coil and with magnetic piece as diaphragm just beyond it. It is screwed into a vessel containing gas or liquid whose pressure is to be measured. Pressures up to 2,000 lb. per sq.in. are recorded.

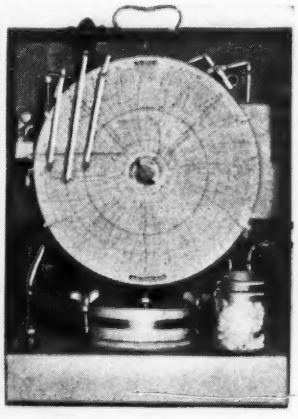
General Electric Co., Schenectady, N. Y.

Portable CO_2 Indicators and Recorders

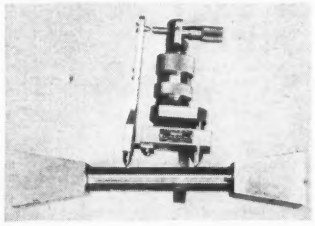
Claimed first and only portable automatic CO_2 indicators and recorders. No moving parts; no running water used; operates on the absorption and Flowmeter principle. Several types. Smallest has indicator reading 0-20 per cent CO_2 in 1-per cent divisions. Case 12¾ in. high, 9¾ in. wide, 5¾ in. deep. CO_2 recorders available with from 1 to 3 pens.

Defender Automatic Regulator Co., St. Louis, Mo.





Miscellaneous Equipment



Extensometer

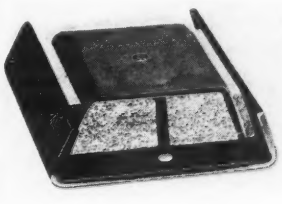
Oxweld extensometers make possible determination of yield points of specimens being tested in Oxweld portable tensile testing machines. Two points of unit clamped on specimen in such manner that elongation between points is multiplied in 5-1 ratio by lever bar making electrical contact with micrometer head. Permits simultaneous determination of ultimate strength and yield point. May also be used as strain gage.

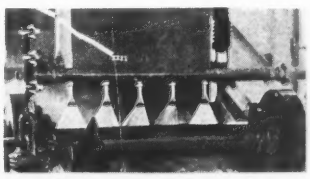
Linde Air Products Co., 30 East 42nd St., New York City.

Vibration Isolator

"Seismo-Damper" consists of an arrangement whereby any isolating material inserted between upper and lower housings is preloaded by maker to proper point. Upper housing drilled and tapped for bolting to base or leg of machine.

Korfund Co., 48-15 32nd Place, Long Island City, N. Y.





"Vest-Pocket" Size Spray Nozzle

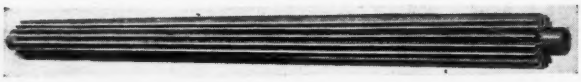
These "Rex" die-cast aluminum spray nozzles are offered for removing débris from intake screens, sluicing ashes and for similar services. Non-clogging, but economical of water, because of flat spray sheet produced by impinging round stream on curved deflector plate with retaining sides.

Chain Belt Co., Milwaukee, Wis.

Scale Retarder

Nalco No. 8 is anti-incrustant or scale retarder for use in feed-lines, heaters, pumps, injectors, regulators, diesel and oil engines, surface condensers, heat exchangers, cooling water, but not for boiler scale prevention.

National Aluminate Corp., 6222 West 66th Place, Clearing Station, Chicago, Ill.



Fin-Type Heat Transfer Elements

For heating or cooling gases of low heat conductivity or liquids of high viscosity, this heat transfer surface uses longitudinal fins on outside of heating elements, thus increasing exterior heat transmitting surface 4 to 6½ times. Patented, known as "G-R G-Fin heat transfer element." Has fins spaced about the circumference of ¾-in. steel pipe and fastened mechanically. Elements may be furnished as separate units or assembled in a suitable shell to form a complete shell-and-tube heat exchanger. No cross baffles necessary.

The Griscom-Russell Co., 285 Madison Ave., New York, N. Y.

Corrosion Preventive

A chemical formula for controlling corrosion and eliminating scale and rust from hot water lines and heaters acts by combining directly with oxygen to form a stable compound thus removing oxygen as a factor in corrosion. "H-O-H-" does not coat piping.

D. W. Herring & Co., 565 W. Washington Blvd., Chicago, Ill.

Rubber Paints

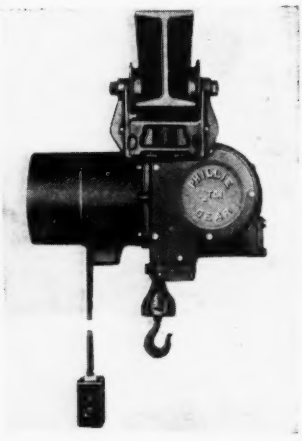
"Acidseal" paints increase adhesion, dry in one hour to a hard, firm film, yet retain rubber's elasticity and its chemically resistant properties. Not water-absorbent.

B. F. Goodrich Rubber Co., Akron, Ohio.

Solid CO_2 Press

A capacity of 62 tons, making a cake of solid CO_2 10 x 10 x 10 in., weighing about 50 lb., this press is unusual in that structural steel construction and welding are used throughout. Carbon-dioxide coming to press is under a press of about 1,400 lb. per sq.in., and somewhat below zero F. Operated by "Hylo" hydraulic power unit.

Southwark Foundry & Machine Co., 400 Washington Ave., Philadelphia, Pa.



Electric Hoist

This hoist, in sizes from ¼ to 3 tons, has these features; high lift with low headroom, noiseless operation, no load break necessary, balanced so load is always under rail center, sealed operating mechanism, close control, short turning radius, interchangeability of parts, heavy-duty construction. Timken roller bearings and standard motor. Hoist push-button controlled.

Philadelphia Gear Works, Erie Ave. & G St., Philadelphia, Pa.

Rust-Preventing Coating

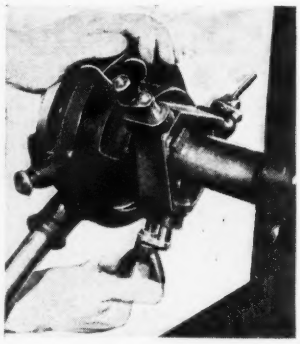
"Rust-Tox," claimed capable of resisting heat up to 550 deg. F., acid fumes, smoke, salt air and oxygen, can be sprayed or brushed at any temperature above 35 deg. F. "Bakes on" under rivet heads in plate joints to leave water and airtight coating.

The Skybryte Co., 1919 East 19th St., Cleveland, O.

High Temperature Paint

Produced in various colors including green, black, red, gray and white, this high-temperature paint is recommended for coating furnace equipment or metal in places where intense heat is encountered. Known as Laclede C-10. Most refractory paint withstands 1,800 deg. F. Colors, including green, gray, red and black, withstand 1,000 to 1,400 deg. F. Shipped in liquid form ready for application. In 1-qt., 1-gal. and 5-gal. cans and in 30-gal. and 50-gal. drums.

Laclede-Christy Clay Products Co., St. Louis, Mo.



Pipe Threaders

"Toledo" 1- to 2-in. "Super" pipe threaders in two models, No. 1B plain and No. 1BR ratchet. Both similar to No. 1 and 1A units except for new diehead and pipe holder. Three-jaw pipe holder obviates bushings. Thumbscrews have large wing heads for convenience. Will thread brass, copper, iron and steel pipe.

Toledo Pipe Threading Machine Co., Toledo, Ohio.

Arc-Welder

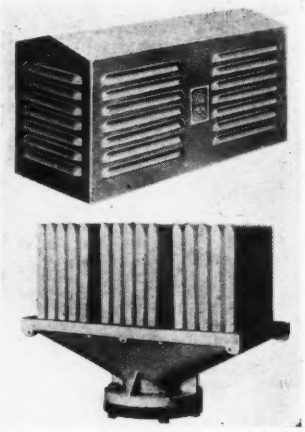
"Shield-Arc" welders provide uniform welding current, thus give faster welding and greater deposit per kw.-hr. Rated at 40 volts instead of former 25 to suit newer rods. Stabilizer or kick transformer eliminated. Dual control for independent regulation of current and voltage. Center-reading volt-ammeter mounted on control panel. Welder entirely inclosed, of arc-welded steel construction. In a.c. and d.c. motor-driven types of 300-, 400- and 600-amp. sizes. Removable running gear.

Lincoln Electric Co., Coit Road and Kirby Ave., Cleveland, Ohio.

Asbestos-Covered Steam Hose

This Type 26 steam hose has a carcass of braided asbestos cords combined with wire. The sizes vary from ½ to 2½ in., all sizes 1 in. and up in three-braid construction (asbestos, wire, asbestos). Two braids (asbestos and wire) are used in ¼- and ¾-in. sizes. 50 ft. is maximum length.

Goodyear Tire & Rubber Co., Akron, Ohio.



Dry Type Filter

Annis air filters, for use on air intakes of compressors, internal combustion engines, and similar service, are of dry type, made in standard units, permitting assembly to give any desired capacity. Each unit consists of a special frame made up of a series of five loops of wire, over which a wool-felt element is fitted.

Coppus Engineering Co., 349 Park Ave., Worcester, Mass.

Metal Spray Gun

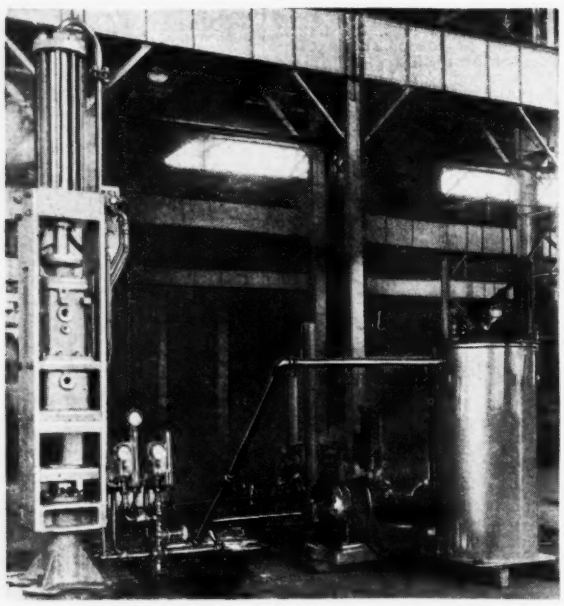
Capable of spraying lead, tin, zinc, aluminum, bronze, stainless steel, Monel, cold rolled and Norway iron on all materials, this "Metalspray" gun is now sold on Pacific Coast by De Laval Pacific Co., 61 Beale St., San Francisco. Unit consists of air turbine supplying power through reduction gears to two knurled wheels which feed metal wires into oxyacetylene flame. Coatings of any desired thickness.

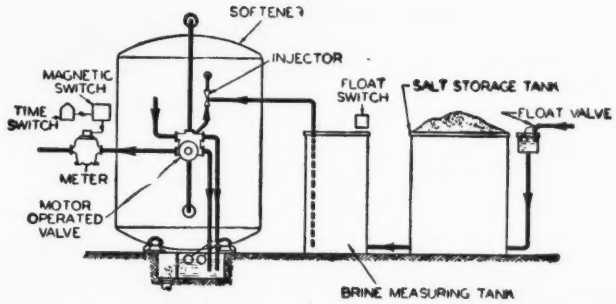
Metal Spray Co., Los Angeles, Calif.

Indirect Water Heater

"B & G Booster" electrically-operated circulator with positive centrifugal pump action, for hot-water heating. By increasing circulation it provides quicker heating with lower boiler water temperature, permits smaller pipe, and corrects installations where pipes are undersize. Booster is element of triple-duty indirect water heater for use on automatically-fired hot water-heating boilers.

Bell & Gossett Co., 3000 Wallace St., Chicago, Ill.

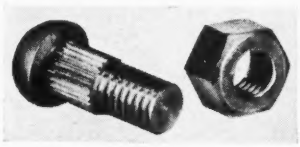




Fully Automatic Water Softener

This fully automatic industrial zeolite water softener eliminates human factor by combination of meter-operated switch and electric controls with a motor-driven Permutit single valve. Thus each operation of softener is conducted under precise control. Sequence: softening, cut-out softener, backwash, salt-brine admission, rinse-out of hardness salts. Automatic control may be applied to existing downflow softeners.

Permutit Co., 440 Fourth Ave., New York, N. Y.



"Rivet Bolts"

Rivet bolts have standard round heads, splined bodies about 1/32 in. larger than drilled rivet hole and shank with Dardelet thread to prevent backing off of nut under vibration. Bolt may be made in steel with ultimate strength of 80,000 lb. per sq.in.; higher strength steels, heat-treated, may also be used. Can be removed and reused.

Dardelet Threadlock Corp., 120 Broadway, New York, N. Y.

Oxygen Absorber

"SeizO_2," stable alkaline solution unaffected by light, claimed to absorb 47 times its volume of oxygen, or four times capacity of pyrogallic acid solution. Used for gas analysis.

Hays Corporation, Michigan City, Ind.

Special Heat Exchanger

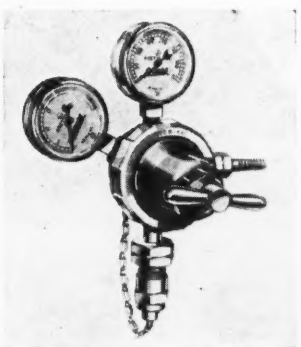
Four straight tubes bonded together mechanically by many closely spaced thin metallic plates. Tubes expanded into holes in plates. Return member connects each pair of tubes at one end. Other end consists of stationary head into which tubes are expanded, and which has inlet and outlet connections. Hot vapor or liquid passes through one set, colder liquid through other set, heat being passed by conduction through metal plates. Called G-R Tube-flo section, Type KC.

The Griscom-Russell Co., 285 Madison Ave., New York, N. Y.

Rubber Packings

Diaphragms, disks, gaskets, etc., now of "Thiokol," a new chemical product with rubber characteristics but unaffected by solvents or oxidation. Recommended for use near gasoline, ether, kerosene, carbon tetrachloride and gas.

Garlock Packing Co., Palmyra, N. Y.



Oxygen and Acetylene Regulators

Oxweld Types R-48 oxygen and R-49 acetylene regulators are for light-duty use, particularly with Type W-15 welding blowpipe. R-48 has a new type of safety release. Hose connections on R-48 are for ¼-in. oxygen hose, on R-49 for ⅜-in. acetylene hose. Other sizes if required.

Linde Air Products Co., 30 East 42nd St., New York, N. Y.

Gasket Compound

No. 1281 gasket compound is grey or brown, odorless and sulphur-free alkyd-resin material, called "Glyptal." Flexible and incompressible, unaffected by oil even up to 230 deg. F. Obtainable in sheets to 13x36 in., from one mil to ⅛ in. thick. Round gaskets available up to 12½ in. in diameter, ⅛ in. thick; larger sizes later.

General Electric Co., Schenectady, N. Y.

Portable Type Threader and Work Bench

Several items have been added to general threader line put out by this company. Illustrated is large size stock, power-driven from Axelson portable threader by means of universal-joint equipped extension shaft. One end takes drive from machine head, other has square socket to suit standard die stocks. Another accessory is a portable workstand with wheels and extension handle. Drawer and base shelf allow ample space for tools, etc.

Axelson Mfg. Co., Los Angeles, Calif.

Rubber Tank Lining

"Triflex," combined soft and hard rubber lining, has 100 times rubber's resistance to impact. Combined with brick sheathing and bonded to metal ash handling systems, etc., for high temperatures and rough service.

B. F. Goodrich Rubber Co., Akron, Ohio.

Acid-Proof Packing

"Super-Cutno" is for use with sulphuric, nitric and other highly corrosive acids. Consists of asbestos lubricated with compound said to resist action of acids, even at high temperatures.

Greene, Tweed & Co., 109 Duane St., New York, N. Y.

Sheet Packing

"Garlock" 660 sheet packing for gasoline, oil and water combines granulated cork with tough paper fiber. Comes in all standard thicknesses from 0.010 to ½ in. In thicknesses less than ¼ in., it can be supplied in rolls 36 in. wide or in sheets. In ¼ in. and greater in thickness, it is furnished in 36-in. sheets.

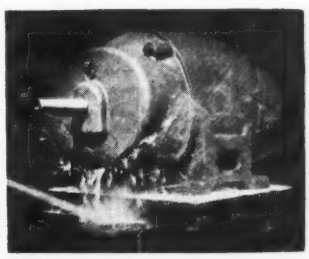
Garlock Packing Co., Palmyra, N. Y.

Water Clarification Method

Nalco No. 41 is sodium aluminate in special form for use in small amounts in clarification of water through pressure filters, for ice plants, and in oil removal filters. Compressed into ball form for use in feeder similar to an alum pot. Feeder is placed on water line or around pump, and a small amount of water by-passed over sodium-aluminate ball. By regulating amount of water by-passed, rate of solution is controlled.

National Aluminate Corp., 6222 West 66th Place, Clearing Station, Chicago, Ill.

Motors, Electrical and Elevator Equipment



Splash-Proof Motor

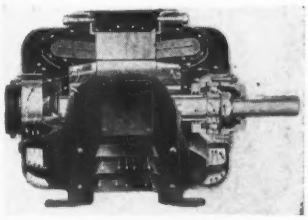
Adequately ventilated and built in same dimensions as standard open motors but designed to prevent entrance of water, this motor uses double baffle in an elliptical-shaped air passage in each endbell to give protection. Illustration shows motor operating at 1,800 r.p.m. and subjected to direct streams of water.

Louis Allis Co., Milwaukee, Wis.

Small A.C. Generators

These a.c. generators for emergency lighting in buildings, etc., have outputs ranging from 1½ kva. to 40 kva. Guaranteed not to exceed 40 deg. C. temperature rise at full kva. load at 0.8 P.F., or 55 deg. C. at 25 per cent kva. overload. Pulley for belt drive or coupling for direct. Timken bearings throughout. Single, 2- or 3-phase windings.

Columbia Electric Mfg. Co., 1292 East 53rd St., Cleveland, Ohio.



Splash-Proof Induction Motors

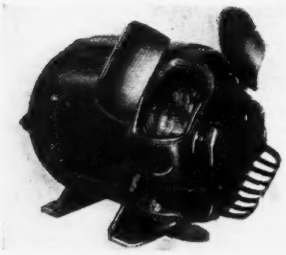
End shields of special construction, top half solid to exclude liquids. Ventilating air enters through openings in bottom half, baffle extending to center of motor shaft. One-piece cover on motor frame.

General Electric Co., Schenectady, N. Y.

Stainless Steel Motor

Dustproof design similar to other similar Lincoln motors, plus inclosure and corrugated heat-radiating surface of stainless steel.

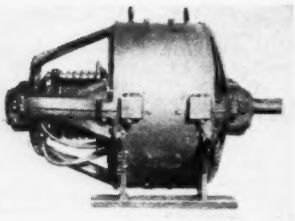
Lincoln Electric Co., Coit Rd. & Kirby Ave., Cleveland, Ohio.



Repulsion-Induction Motors

Type RG repulsion-induction motors have smooth speed-torque curve throughout operating range and possess these characteristics: low starting current, close speed regulation, positive operation on low voltage, high power factor, good commutation and no internal short-circuiting or brush-lifting mechanism. Bolt holes permit 90-, 180-deg. rotation of end plates.

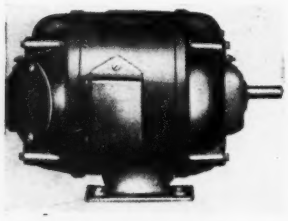
Wagner Electric Co., 6396 Plymouth Ave., St. Louis, Mo.



Direct-Current Motors

Larger motors for Type T direct-current line range in size from 100 hp. at 800 r.p.m. to 350 hp. at 1,200 r.p.m. Rolled-steel split-frame construction, with feet and supporting members of heavy bar steel welded to frame. Six main poles and six commutating poles. Brackets and sleeve bearings split. Brushholders combine advantages of reaction and box type. Brush studs of steel, cadmium-plated. Constant-speed or adjustable-speed service with 2 to 1 or 3 to 1 range.

Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland, Ohio.



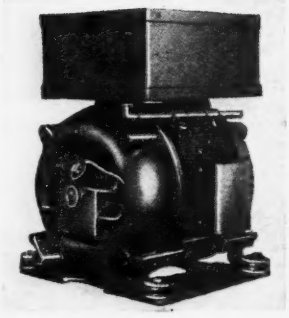
Motors Single-Phase Induction

Brush-riding, single-phase repulsion-start induction motors intended primarily for applications where quiet operation or higher operating characteristics are not required.

Century Electric Co., St. Louis, Mo.

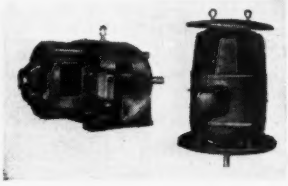
Capacitor Motors

Sizes from ¼ to 10 hp. for single-or multi-speed operation with normal- high- or low-torque characteristics. Small sizes have capacitor on top of



motor, although boxes can be supplied for wall mounting as in larger sizes. Intermediate sizes have separate capacitor boxes which may be furnished for either wall or floor mounting.

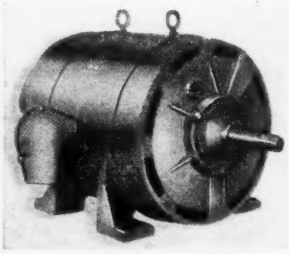
Century Electric Co., St. Louis, Mo.



Vertical and Slip-Ring D.C. Motors

Type R d.c. motors for vertical operation are ball-bearing equipped, grease lubricated and mounted on ring base or directly on driven equipment. Sizes 1-150 hp. Line of slip-ring motors extended from 20 to 250 hp., 1,800 r.p.m., 60 cycles. Complete line now ¼-250 hp.

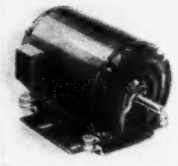
Century Electric Co., St. Louis, Mo.



Induction Motors

Ranging from ¾ to 200 hp., this line of induction motors has frame fabricated from bar steel, electrically welded. Open, fully inclosed, or fan-cooled types.

Reliance Electric & Engineering Co., 108 Ivanhoe Road, Cleveland, Ohio.



Built-In Capacitor Motor

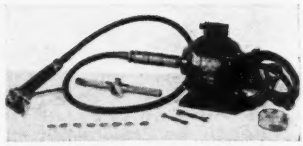
"Red Band" fractional-horsepower, built-in capacitor motors also manufactured in rigid or rubber-mounted vertical types with register, flange and other mounting, and also as stators and rotors for built-in equipment. Sizes vary from ¼ to ¾ hp. Units 110-volt, single-phase, 60-cycle, 1,735-r.p.m. full-load speed.

Howell Electric Motors Co., Howell, Mich.

Electro-Graphitic Brush for Heavy-Duty D.C. Generators

National Pyramid grade No. 234 electro-graphitic brush, developed for use on heavy-duty d.c. generating and sub-station equipment, has non-resilient structure to maintain firm contacts on commutators at high peripheral speed. Also has low friction and high carrying capacity, combined with smooth riding properties, to minimize brush wear and commutator maintenance.

National Carbon Co., Cleveland, Ohio.

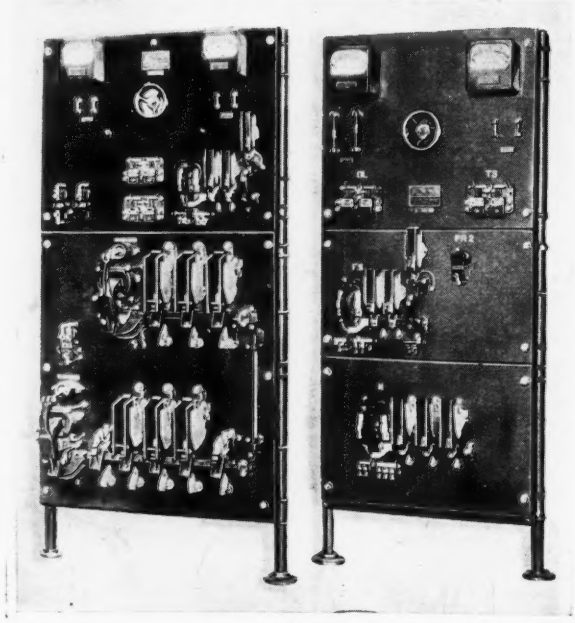


Mica Undercutter for Commutators

Improved Ideal mica undercutter for commutators can be used on machines with but 2¾-in. clearance without guide assembly or 3½-in. space with guide attached. Small head and saw permits cutting to within ¼ in. of riser. Locking micrometer adjustments are provided for depth, width and pitch of slot. Auxiliary handle, adjustable for right or left hand, gives convenience in holding, and special shop handle is also available.

Ideal Commutator Dresser Co., Sycamore, Ill.

Starters, Safety Switches and Circuit Breakers



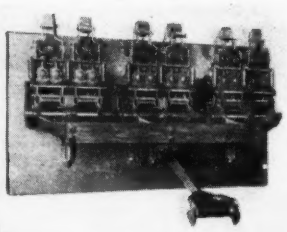
Starters for Synchronous Motors

A frequency-responsive relay which functions in connection with an adjustable time delay thermal overload relay is important in the operation of this addition to line of automatic and semi-automatic starters for synchronous motors. In case of heavy overload, reduced line voltage, failure of motor field or loss of excitation, frequency relay disconnects field switch and permits motor to operate as a squirrel-cage motor for 30 sec. Should normal conditions return within this time, motor will re-synchronize and continue in operation, otherwise it will be disconnected from the line. Efficiency relay also controls field excitation automatically. Sizes from 25 to 600 hp. for voltages of 220, 440, 550 and 2,200.

Cutler - Hammer, Inc., 294 North 12th St., Milwaukee, Wis.

Air Circuit Breakers

AL-2 manually and electrically operated air circuit breakers are rated up to 750 volts and 10,000 amp. Single-,



double-, triple- and four-pole arrangements. Multi-pole breakers consist of two or more self-contained single-pole units mechanically interconnected. Breakers trip-free.

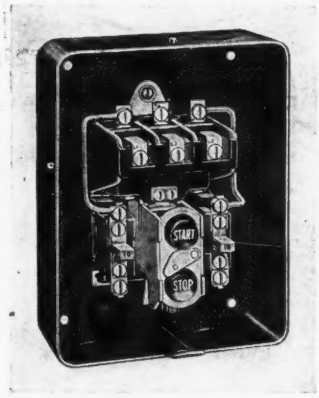
General Electric Co., Schenectady, N. Y.

Explosion-Resisting Linestarter

Developed for use in Class I, Group D, hazardous locations as described in National Electric Code (where highly flammable volatile liquids or gases are manufactured, used or handled). Consist of standard

line-starter units mounted in heavy cast-iron cabinets with wide flanges. Built with separate mounted or built-in push-button.

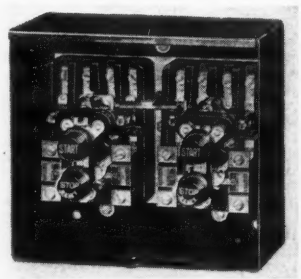
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Hand-Operated A.C. Starting Switch

Bulletin 609 compact manually operated starting switches will control small a.c. motors and give overload protection. Two overload relays provided; tripping of either opens contactor. Either relay can be reset without opening cabinet. Two sizes, Size 1 (smaller) 3-pole; Size 2 has 3 and 4 poles. Size 1 will handle self-starting single-phase motors up to 1 hp., 110 volts and 2-hp., 220 volts, and polyphase motors up to 2 hp. at 220, 440 and 550 volts. Size 2 is rated at 5 hp., 220 volts and 7½ hp., 440 and 550 volts, for 2- and 3-phase motors.

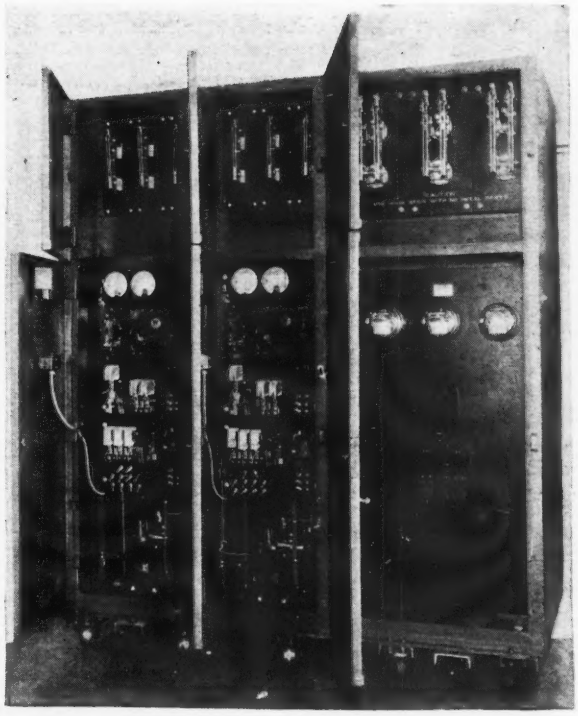
Allen-Bradley Co., 1311 *South First St., Milwaukee, Wis.*



A.C. Manual Starter Reversing and Two-Speed

Two-speed, separate-winding type and single-speed reversing line starters for controlling across-the-line motors have maximum ratings of 5 hp., 220 volts, and 7½-hp. for 440 to 550-volts. Front operation, thermal overload protection, operation of any relay opens main line completely, disconnecting motor from line. Brake switch mechanisms interlocked to prevent simultaneous operation, push-button resets without replacement of parts after overload. 13⅜ in. wide, 10⅞ in. high, and 5½ in. deep.

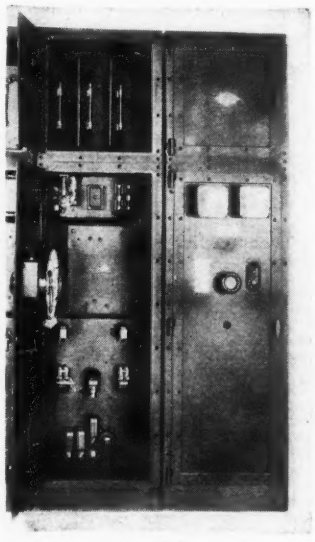
Industrial Controller Division, Square D Co., Milwaukee, Wis.



Synchronous Motor Starter

This synchronous motor starter, entirely inclosed in cubicle for protection against dust, has three compartments. One contains incoming line circuit breaker with disconnect switches; others house individual synchronous motors starters with electrically-operated breakers and individual disconnect switches. Individual motor exciters controlled from motor-starting pushbutton.

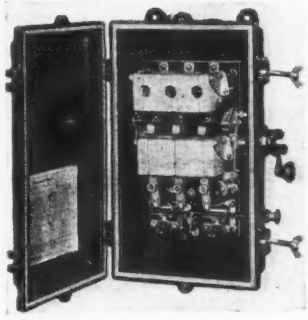
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Cubicle Starter for Synchronous Motors

Cubicle type automatic starters for synchronous motors use front compartment for meters, control relays, rheostats and filed contactor, rear compartment for oil-break line switches, and upper compartment for disconnects. Starter designed to permit easier access to working parts.

Electric Machinery & Mfg. Co., Minneapolis, Minn.



A.C. Combination Starters

A. C. combination starters of water- and dust-tight construction in cast-iron have been added to this company's line. Not explosion-proof. Unit consists of an across-the-line starter, motor control switch and test jack. Thermal overload protection and low-voltage protection provided. Starters built in two sizes, Class 8532S and 8536S; can be furnished fusible or non-fusible.

Industrial Controller Division, Square D Co., Milwaukee, Wis.

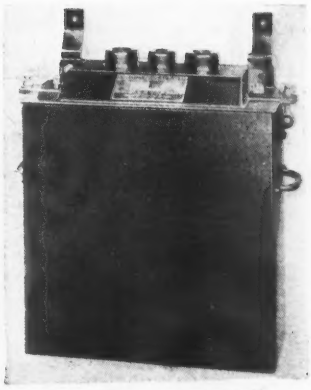
Switchgear

To meet requirements of industrials, building equipments, and power station auxiliaries, this line of switchboards employs air circuit breakers for control and protection of power and lighting lines. Breakers are trip-free and can be manually or electrically operated. Ratings are up to 750 volts and 4,000 amp. a.c., and 6,000 amp.

General Electric Co., Schenectady, N. Y.

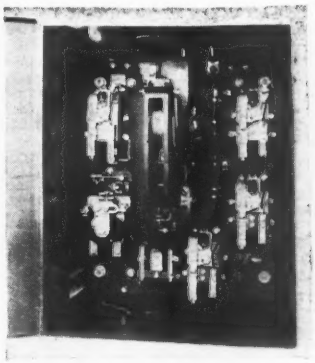
Explosion-Proof Starter for Hazardous Locations

Class 8528 explosion-proof a.c. automatic starters for use in hazardous locations are of oil-immersed type and control across-the-line single and poly-



phase motors. Ratings 5 to 50 hp. for 220-volts and 7½ to 75 hp. for 440- and 550-volts. Starter is cast-iron head, welded steel tank and starter panel carrying a three-pole magnetic contactor and two oil dashpot overload relays. Visible gage indicates maximum, normal and minimum oil level.

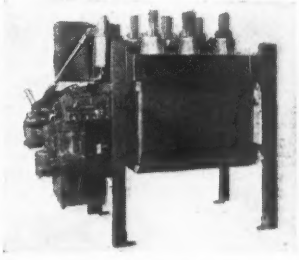
Industrial Controller Division, Square D Co., Milwaukee, Wis.



Non-Reversing Time Limit Starter

For use with non-reversing constant-speed d.c. motors on pumps, fans, hoists, etc., "Timetactor" provides definite time limit acceleration without requiring intermediate relays. Controller designed to operate over widest variation in voltage on which d.c. motor will operate satisfactorily. Starter compact. 75-hp., 230-volt unit illustrated is 19 in. wide, 25 in. high and 22 in. deep.

Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

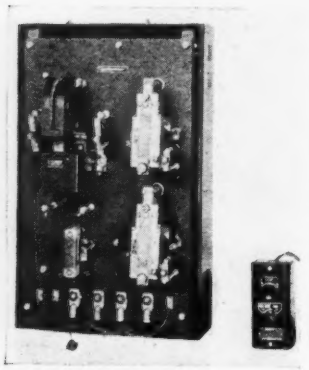


Oil Circuit Breaker

Type Y-100 circuit breakers are for indoor, high-amperage circuits of 7,500 volts or less. Inclosed-mechanism type with all poles in one tank. Non-oil throwing, high speed of operation, small space requirements and provision for venting. Furnished manually or electrically

operated for 2,000 to 3,000 amp. at 7,500 volts or less, with estimated interrupting capacity of 100,000 kva.

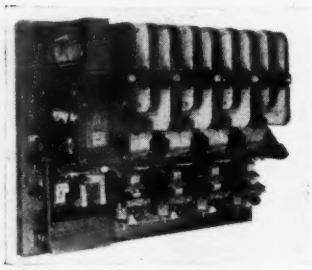
Condit Electrical Mfg. Corp., 1344 Hyde Park Ave., Hyde Park, Boston, Mass.



General-Purpose Mill-Type Starters

Designed for constant-speed d.c. motors, these starters utilize newly developed accelerated contactors designed to act both as a relay to provide time delay, and to short out starting resistor by means of a contact finger. Accelerating contactors are equipped with silver-faced tips to eliminate oxidation difficulties. Starters available from 1 to 75 hp.

General Electric Co., Schenectady, N. Y.



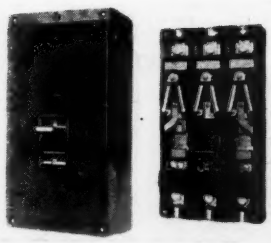
Solenoid-Operated Air Circuit Breakers

Types KJ, KS (switchboard mounting), KJB and KSB (enclosed) are extremely compact solenoid-operated air circuit breakers. 1, 2, 3 or 4 poles, 600 volts a.c. or 250 volts d.c. Types KJ and KJB, 2-150 amp.; Types KS and KSB, 200-300 amp. Closing coil designed for momentary contact control; for maintained contact control a trip-free relay and timed "break" switch are included. Main switch members trip-free mechanically from closing magnet through simple standstill latch. Easily replaceable contacts of special material. Arc extinguishers, shunt trip, and dual overload series trip coils included as standard equipment.

I.T.E. Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia, Pa.

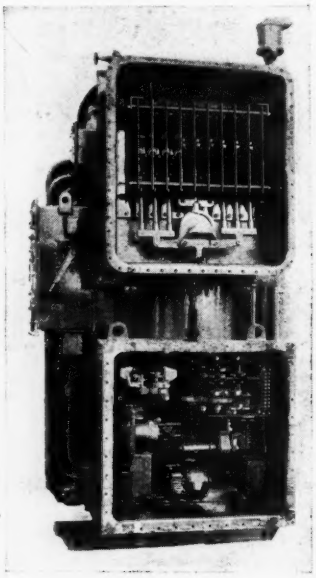
Deion Principle Applied to Low-Voltage Circuit Breakers

This new line of low-voltage circuit breakers uses deion principle previously developed for high-voltage breakers. In conjunction with thermal time-delay and instantaneous-trip



features they compare favorably in cost and space requirements with prevailing combinations of carbon circuit breakers and fuses used at distribution centers in buildings and factories. Ultimately line will extend from 15 to 600 amp. on voltages up to 600 for a.c. and 250 for d.c. Illustrated is three-pole, 225-amp. deion breaker for 125, 250 and 575 volt ratings.

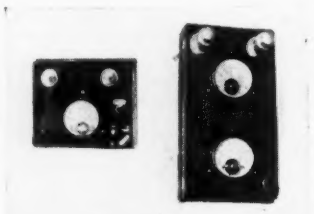
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Tap Changer for Transformers

Tap changer practicable for application to transformers as small as 500 kva. per phase and suitable for both single and 3-phase ratings. 3-phase rating forms part of standardized equipment for primary distribution service. Tap changer consists of selector switches for selecting proper tap, transfer switches for transferring load from one tap to another and motor-operated mechanism with equipment for automatic operation.

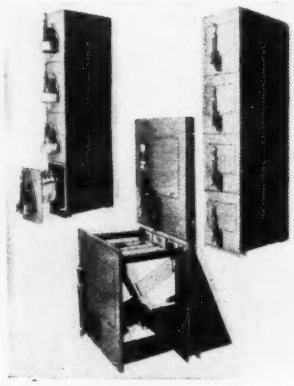
Westinghouse Electric & Mfg Co., Inc., East Pittsburgh, Pa.



Midget Voltmeter

Sullivan "Migit" volt-ammeters are self-contained units small enough to be carried in an overall pocket. No shunts necessary. Maximum voltage, either a.c. or d.c., is 600, and maximum amperage 300.

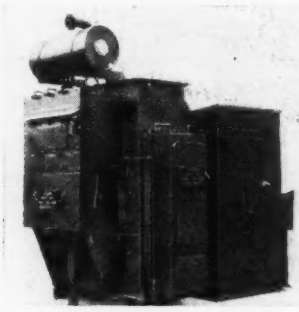
Sullivan Machinery Co., 400 North Michigan Ave., Chicago.



Sectional Steel Dead-Front Switchboards and Cubicles

Switchboards may be made up of indicating and recording instruments and dead-front knife switches or combinations. Complete switchboards are built up of units, each containing one breaker. Units placed one above another to form a stack and stacks placed side by side to form complete switchboard. Each units is two parts—frame and removable breaker carriage.

Roller-Smith Co., 233 Broadway, New York, N. Y.



Packaged Sub-Station Unit

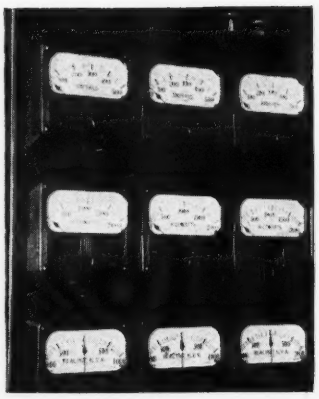
Transformer and switch gear designed as unit and assembled at factory are incorporated in the sub-station unit. Design permits additional feeders to be provided, as required. Equipment includes three-phase transformer, high-voltage oil-immersed disconnecting switch, inclosed high-voltage fuse compartment, automatic equipment for changing ratio of high-voltage winding under load, and necessary switch gear. Metal enclosed. Size approximately 12 x 10 ft. Each additional feeder position adds approximately 2½ ft. to the 12-ft. dimension.

General Electric Co., Schenectady, N. Y.

Soldering Lugs

Soldering lugs of special construction providing two bolts each. Will not permit cable to fuse in case of sustained short circuits. Furnished only in long-tongue, two-hole style. Heavy-duty lugs interchangeable with standard cast lugs.

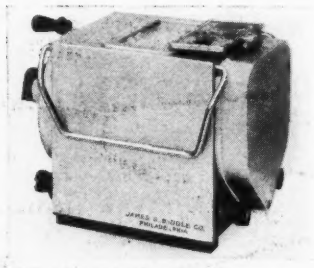
H. B. Sherman Mfg. Co., Battle Creek, Mich.



Square-Case Switchboard Instruments

Properly-proportioned square cases to utilize a minimum of switchboard space feature H line of instruments. Both a.c. and d.c. instruments are intended for service on large switchboards of steel, ebony asbestos, or slate. All have small size, long clearly-marked scales and greater overload capacity than usual.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Direct-Reading Ground Tester

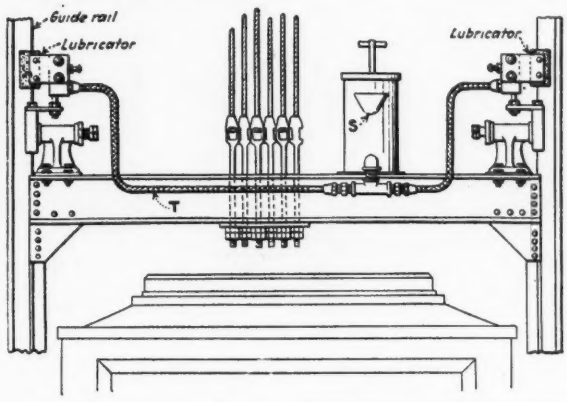
"Meg" ground tester operates on same principle as "Megger," having self-contained hand generator to furnish a.c. for test, and direct-reading pointer-type ohmmeter. Instrument connected to ground under test and to two reference grounds. Crank is turned and ground resistance read in ohms. Instrument not affected by polarization, electrolysis or by stray currents in earth. Ranges up to 300, 600 and 1,000 ohms. Scales logarithmic. Calibrated in single ohms up to at least 20, then in larger units to the full scale values.

James G. Biddle Co., 1211 Arch St., Philadelphia, Pa.

Insulating & Cooling Medium for Electric Equipment

"Pyranol," a synthetic liquid insulator, combines advantages of mineral oil as an insulating and cooling medium for electrical equipment, but also is non-inflammable and non-explosive. Composition varies for different purposes, all being synthetic organic dielectrics. Apparatus must be designed especially for its use. Liquid is chemically stable and resists oxidation. It is clear in color, has Saybolt viscosity of 4 sec. (37.8 deg. C.), pour point of minus 30 deg. C., and dielectric constant of 5.

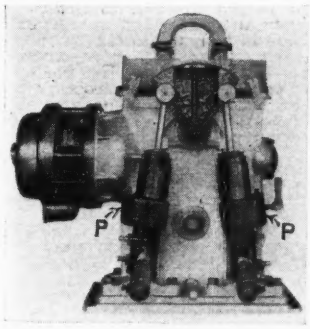
General Electric Co., Schenectady, N. Y.



Pressure Reservoir Type Guide-Rail Lubricator

This automatic lubricator applies heavy oil or light grease under positive pressure to guide rails from central reservoir on car and on counterweight cross-head. Connection to lubricant distributors by metal tubes shown. To replenish lubricant in reservoir, pull piston to top of reservoir and fill latter by pouring lubricant into spout *S*. Piston weighted to maintain pressure head on lubricant.

Yvan Zenon, 244-22 136th Ave., Rosedale, N. Y.



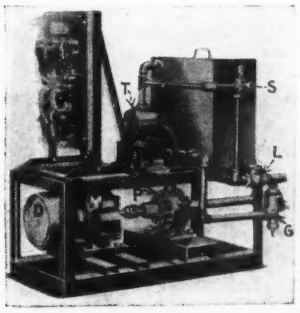
High-Speed Electric Operator for Elevator Doors

Standard induction motor supported directly on case of double-reduction gear supplies power to this operator, mounted on top of the car just above door. Aluminum housing for gears. Dashpot provides double-acting check arrangement on doors of any size up to 5-ft. door travel. Motor, 110- or 220-volt, 3-phase, 60-cycle. Will operate any hoist rail car door that travels horizontally. Car and hoist with door motion controlled from regular car control handle, operated automatically from elevator control. Hand operation in case fuse blows.

Elevator Supplies Co., Inc., Hoboken, N. J.

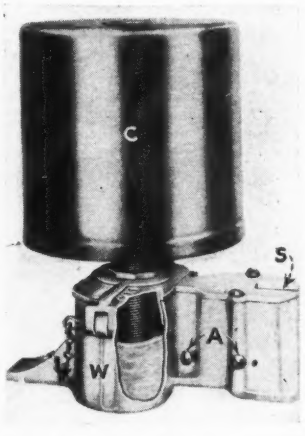
Hydraulic Elevator with Push-Button Control

Hydromatic elevator for use in two-story buildings and for sidewalk lifts has control valves designed to secure smooth and accurate control. A feature is elimination of pent houses and overhead supports. Welded steel frame. Hydromatic control valve is rotary disk-type



operated by torque motor. Opening and closing speeds regulated by spring-loaded hydraulic two-speed piston check. Speeds up to 100 ft. per minute and over. Speed governor valve *G* installed at circuit ahead of control valve. Load-holding valve *L*. Overload safety valve *S* set for pressure approximately 10 per cent higher than that required for maximum load. Special wound motor *M* and torque-dampening flywheel produce good acceleration with simple across-the-line magnetic starter. Pump *P* is of the herringbone-gear type.

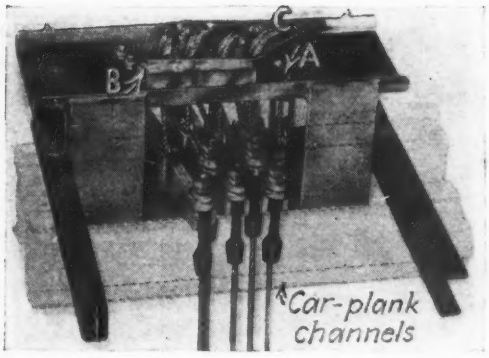
F. Rosenberg Elevator Co., Milwaukee, Wis.



Guide-Rail Lubricator for High-Speed Elevator

This lubricator applies heavy oil uniformly to guide rails regardless of elevator speed or building height. A nipple threaded through cover of oil well *W* supports oil container *C*. By turning container, lower end of nipple is raised or lowered into oil well and in this way oil level in well is adjusted to obtain proper feed to rail for satisfactory lubrication. Lubricator supported on top of guide shoe so that guide rail passes through slot *S* and is surrounded on all three sides by a felt wiper that syphons the oil from well. Adjusting screws *A* compensate for wear. Container has ¼-gal. capacity. Lubricator can be applied to either standard ⅝- or 1¼-in. rails and can be regulated to feed light, medium or heavy oil.

Albert Johnson, 1150 Broadway, New York, N. Y.



Automatic Equalizer for Compensating Ropes

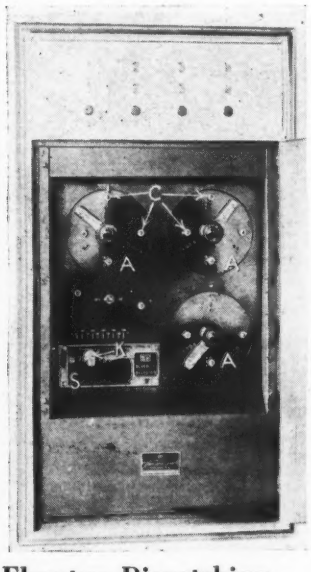
This type compensating-rope equalizer has rope shackles connected to end of horizontal equalizing bars, which have opposite ends pivoted between two channels. Near the center of each bar is a sheave from which it is supported by an equalizing rope deadened at *A* and *B*, and also passing around fixed sheaves *C*.

Evans Elevator Equalizer Co., 70 East 45th St., New York, N. Y.

Cable Compound

"H-C" non-slip elevator cable compound claimed to lessen cable slippage, which causes unequal tensions, false stops, etc.

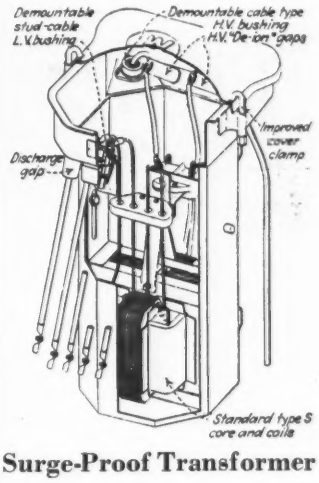
Hazard Wire Rope Co., Wilkes-Barre, Pa.



Elevator Dispatching Machine

Automatic elevator dispatching with several improvements embodied in this unit. Machine consists of driving motor *M*, schedule selector *S*, and three rotating arms *A* for flashing dispatching lights in car. Driving motor is standard geared-head type. On motor output shaft is a spring clutch to connect motor to schedule selector. Clutch also acts as safety device. Ten steps of speed changes are provided in schedule selector by shifting position of knob *K*. Arms rotate over key-type contacts *C* and flash dispatching lights in cars.

Elevator Supplies Co., Inc., Hoboken, N. J.



Surge-Proof Transformer

This distribution transformer, which is not injured by lightning surges entering either primary or secondary, has protection independent of external connections or ground resistance.

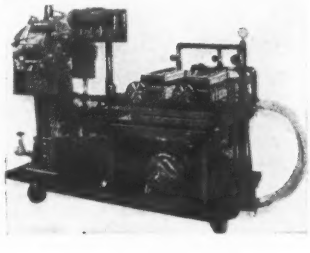
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

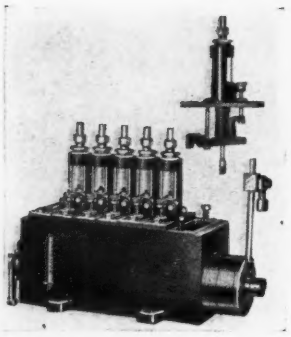
Oil Filters, Purifiers, Lubricators

Centrifugal Oil Purifier

Oil is centrifugally purified under high vacuum in "Deoxator." Not only does it remove free air in oil but also 90 per cent of oxygen in solution or any dissolved moisture. Used for filling and drying out new equipment. filling inertaire type transformers, substituting air in transformers, and similar work. Centrifuge bowl used to remove free water and sludge.

Sharples Specialty Co., 23rd & Westmoreland St., Philadelphia.

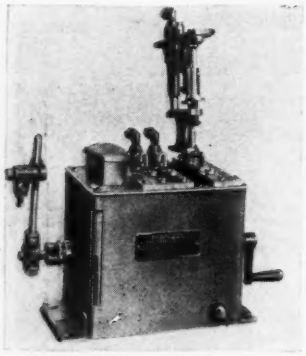




Force-Feed Lubrication

In this force-feed lubricator, single plunger serves dual purpose of drawing oil from reservoir and forcing it in straight vertical path through sight glass to point of lubrication at end of feed line. Each pumping unit is easily adjusted and removable while lubricator is in operation. Sight glasses refilled by standard lubricating fitting and grease gun. Any number of feeds and any type of driving mechanism.

S. F. Bowser & Co., Fort Wayne, Ind.



Improved Force-Feed Lubricator with Removable Pumping Units

Model 25 lubricator delivers oil of any viscosity in accurately measured quantities against high steam, gas and air pressures. Built on double-plunger principle, with individual pumping unit for each point lubricated. Any unit may be removed without stopping lubricator or equipment, or interfering with other units. Valve cages complete may be removed for replacement. Each pumping unit independently adjustable up to 30 feeds, in any desired capacity, with either ratchet, rotary or direct drive. Standard outlet fittings for ¼-in. o.d. tubings with $\frac{5}{16}$-in. o.d. tubing or ⅜ or ½-in. iron pipe fittings optional. Double-compartment lubricators for feeding two kinds of oil available. Illustrated is lubricator with one pumping unit being removed.

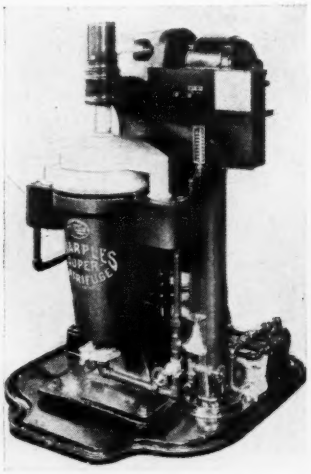
Manzel Bros. Co., 315 Babcock St., Buffalo, N. Y.

Automatic Oiling System

This automatic oiling system operates electrically without pump or other moving parts. Consists of oil tank made by Westinghouse, equipped with heater unit separated from direct contact with oil. Electric heater unit within tank turns on automatically when machine is started, thus raising oil temperature to cause expansion and

force oil out of tank to bearings. When temperature reaches 150 deg., thermostat breaks contact, allowing oil to cool to 100 deg. Then vacuum occurs, utilized to refill tank from central supply or reservoir. Check valve prevents oil being drawn back from bearing.

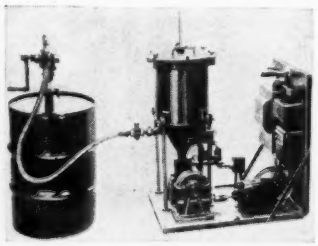
Motor & Plane Accessories, Inc., Detroit, Mich.



Oil Purifying Unit

A complete oil purifying plant designed especially for the purification of diesel engine fuel and lube oil, turbine oil, etc., is known as Sharples En Bloc oil purifier. Combines purifier of high centrifugal force with pumps, meters, pushbutton controls and accessories, all on a common base and piped and wired together so that installation requires but two pipe connections and one electrical.

Sharples Specialty Co., 23rd & Westmoreland St., Philadelphia, Pa.



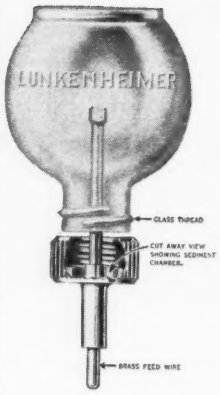
Single-Line Multi-Feed System for Greases

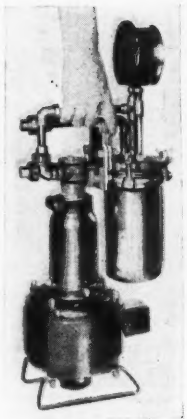
For mechanical application of light greases and heavy oils to parts requiring regular lubrication, this motor-driven single-line system is positive, accurate, rugged, and simple. A grease pump loads the hopper. Heating unit warms grease in winter. Independent mechanical measuring units at each bearing.

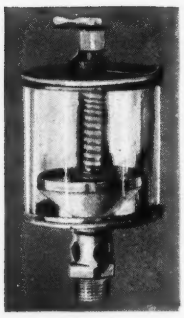
Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.

Bottle Oiler

Three major parts — glass bottle with threaded neck, bronze base with integral sleeve-



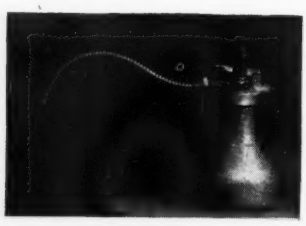




Oil-cup filter

type shank, and brass feed wire. Thick resilient cork washer seals joint between bottle and base. Oiler entirely automatic in operation, feeding only when shaft is in motion.

Lunkenheimer Co., Cincinnati, Ohio.



Pressure Oiler

This portable, pressure-type spray oiler has cast aluminum body and thumb-operated trigger. Long adjustable nozzle provides one-hand oiling. Air to create pressure supplied by hand pump pressure outlet.

Techno Products Co., 7523 Santa Fe Ave., Huntington Park, Calif.

Portable Oil Filter and Motor-Driven Pump

A portable combination oil filter and motor-driven oil pump is now available. Pump suction is connected by flexible metal hose or regular piping to oil drain in the reservoir, and discharge is similarly connected to inlet. Operated from electric light socket. Several sizes manufactured, from 65 to 2.000 gal. per hr.

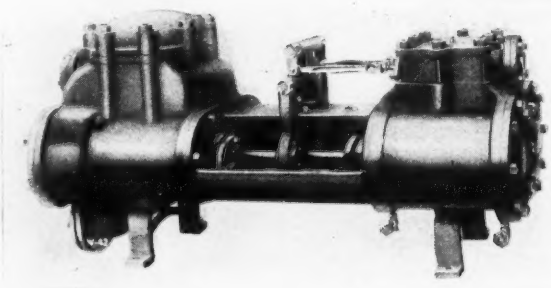
William W. Nugent & Co., 410-412 N. Hermitage Ave., Chicago, Ill.

Oil Cup Filter

Special impregnated felt is filtering medium in this filter. Oil passes upward to inside of cone, thence out through exit hole in cup's center tube to bearing. Thus, filter membrane works in semi-inverted position protected from all direct pollution by coarser and heavier settlings from oil. Sizes for practically all standard oil cups.

H. B. Morrow Co., Mishawaka, Ind.

Pumps for Power Plant and Industrial Uses



Horizontal Duplex Steam Pump

Designed and fitted for handling either water or chemical solutions in valve plate, turret and pot valves, horizontal duplex steam pumps have stainless steel drop-forged valves. Valve plate type capacities from five to 320 g.p.m. up to 250 lb. per sq.in. Turret-type capacities 150 to 840 g.p.m., pressures to 75 lb. per sq.in., and capacities 100 to 500 g.p.m. for pressures up to 200 lb. per sq.in. Pot valve type: For pressures up to 500 lb. per sq.in. with capacity of 40 to 96 g.p.m., have special steam end. For boiler feed service, capacities of 15 to 760 g.p.m., and discharge pressures to 300 lb. per sq.in., standard steam ends, and liquid ends of outside end-packed-plunger pot valve pattern. For pressures up to 500 lb. per sq.in., and capacities of 140 to 1,800 g.p.m., cylinders fitted with bronze liners.

Worthington Pump & Machinery Corp., Harrison, N. J.

Centrifugal Pump

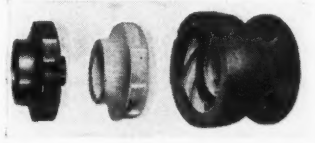
"Electropump" is centrifugal unit for small and moderate capacities for operation against heads up to 150 ft. or 65 lb. pressure in a single-stage unit, and twice the head or pressure

when furnished with two stages in series. It is used for circulating hot and cold water or brine, for water supply systems and booster service, and similar work. Motor and pump are built into one unit to reduce rotating parts. Unit consists of single-stage, single-suction, fully bronze-fitted pump with close-coupled motor. Impeller of inclosed type, mounted, keyed and locked on extension of motor shaft. Known as Type E, available in 1, 1½ and 2-in. sizes.

Lawrence Pump & Engine Co., Lawrence, Mass.

Porcelain Surfaces for Turbine Pumps

Application of porcelain similar to that used on plumbing materials for coating impellers or runners and bowls of deep-



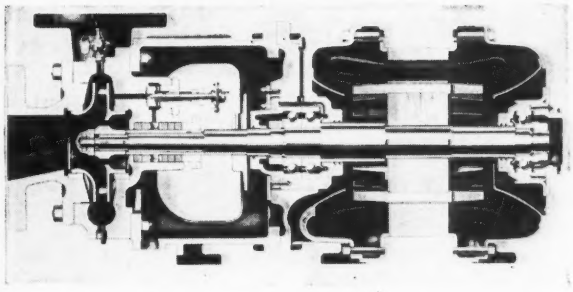
well turbine pumps is said to increase pump efficiency approximately 5 per cent and to be completely acid-resistant and resistant to sand abrasion also.

Johnston Pump Co., 2324 E. 49th St., Los Angeles, Calif.

Direct-Acting Close-Clearance Steam Pumps

"HiVol" steam pumps have suction and discharge valves at extreme end of liquid cylinder, suction below and discharge above piston on cylinder center line. Hand bypass valve fitted. Liquid cylinder of Wompco metal, designed for 400-lb. working pressure. Cylinder liner, Ni-Resist, removable.

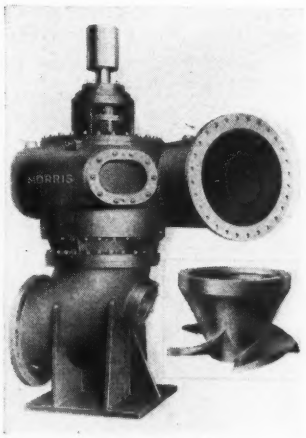
Worthington Pump & Machinery Corp., Harrison, N. J.



Combined Motor and Pump

Cameron "Motorpumps" range in size from ¼ to 25 hp. and handle from 5 to 800 g.p.m. of any light liquid. Is complete pumping unit with built-in motor of open, inclosed or explosion-proof type. Heads up to 100 ft. Dust-proof construction.

Ingersoll-Rand Co., 11 Broadway, New York, N. Y.



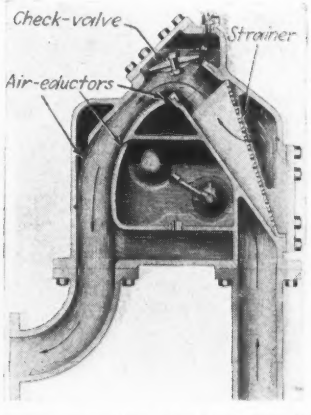
Propeller Type Pump

This pump has propeller of screw type with widely spaced open vanes which pass solids of large size without danger of clogging. Design also permits delivering large quantities of water at low head when operating at comparatively high speed, making pump suitable for direct motor drive. Sizes 16 in., and larger and for horizontal or vertical drive.

Morris Machine Works, Baldwinsville, N. Y.

Suction Line Primer with Strainer and Check Valve

This priming device for centrifugal pumps combines in one casting check valve, strainer and air-removing device. Various sizes have maximum capacity of 1,500 g.p.m. and maxi-



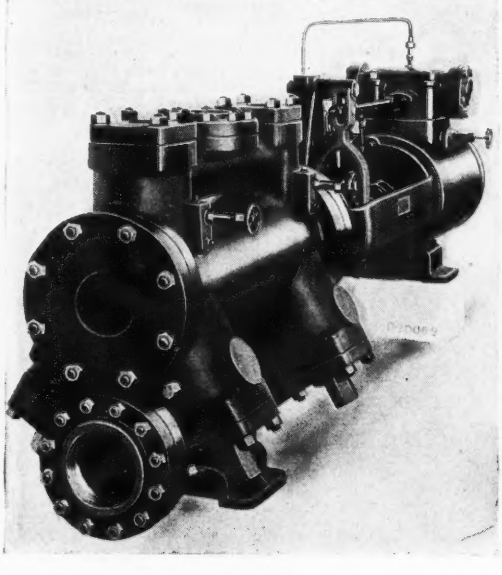
mum operating head of 200 ft. When combined with special control panel it makes possible automatic operation of pump with complete protection against loss of water, air leaks and break of column line.

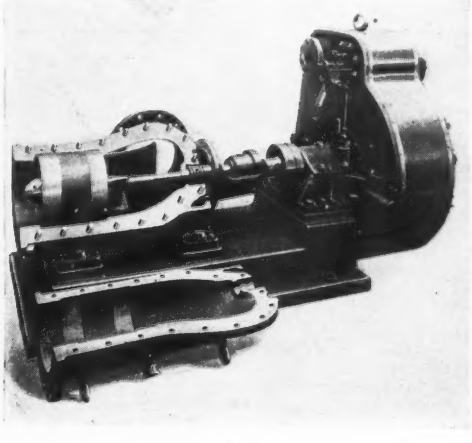
Barrett, Haentjens & Co., Hazleton, Pa.

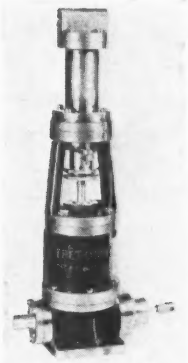
Propeller Pumps

For handling large volumes of liquid against low heads, this propeller pump is built for both horizontal and vertical installation. Available for all capacities and for heads up to about 40 ft. Can be direct-connected to standard speed electric motor or steam turbine, or speed reducing gear may be used. Pump casing in two parts, separated in plane of center line of shaft by a flat joint with gasket.

De Laval Steam Turbine Co., Trenton, N. J.







Jackson Centrifugal Pump

Automatic Proportioning Pump

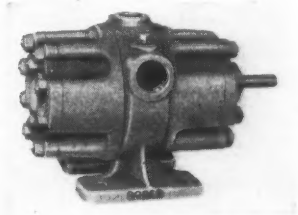
For controlling injections of accurate percentages of chemicals or reagents in treating operations or for securing accurate samples of liquids, Tret-O-Unit pump is controlled by the flow of untreated fluid. Assembly consists of a hydraulically balanced control valve, shuttled back and forth to control stroker per minute taken by fluid motor above it. Fluid motor is direct connected to single stroking plunger pump which charges treating fluid.

Proportioneers, 7701 Avalon Ave., Chicago, Ill.

Low-Capacity Centrifugal Pumps

Designed similarly to maker's double-case, hot-oil pumps. Units in 3, 5, 7½ and 10 hp., 60-cycle. 3 and 5-hp. units direct-connected, operate at 3,600 r.p.m. to handle from 10 to 30 g.p.m. Inner volute of 3-hp. pump 10 stages; 5-hp., 16 stages. Pumps designed for gear drive, operating from 1,750-r.p.m. motors to pumps of 5,000 to 5,900 r.p.m. Capacity 10-30 g.p.m. at pressures of 500 lb. (10-hp.) and 375 lb. (7½-hp.).

Byron Jackson Co., Foot of Carlton St., Berkeley, Calif.



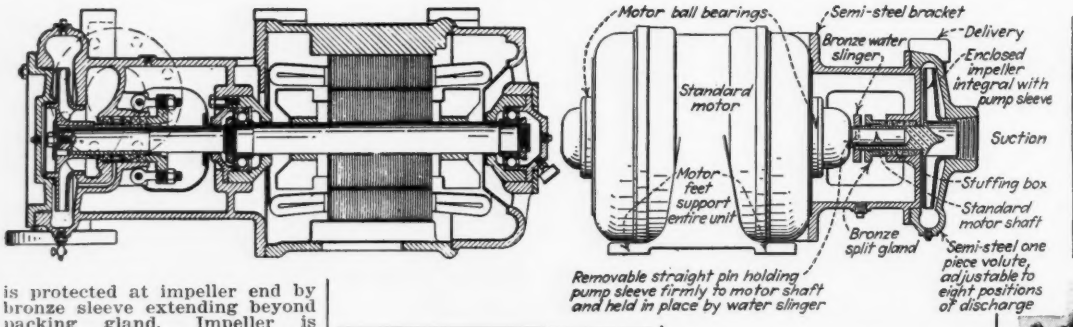
Hydraulic Pumps

Series 996 and 998 pumps will develop pressures up to 300 lb. per sq.in., Series 999 up to 100 lb. Series 996 and 998, in 9 sizes, have capacities from 4-100 g.p.m.; Series 999, in 10 sizes from 1-100 g.p.m.. Series 996 pumps have single-row ball bearings, others sleeve bearings.

Geo. D. Roper Corp., Rockford, Ill.

Self-Contained, Motor-Driven, Single-Stage Centrifugal Pump

Class LS single-stage centrifugal pump is pump and driving motor in compact self-contained unit with one shaft serving both pump and motor. Shaft is carried in two ball bearings and

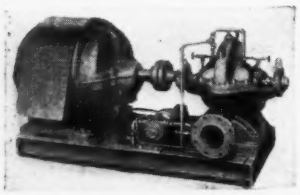

Motor ball bearings
Semi-steel bracket
Delivery
Bronze water slinger
Enclosed impeller integral with pump sleeve
Standard motor
Suction
Motor feet support entire unit
Stuffing box
Standard motor shaft
Bronze split gland
Semi-steel one piece volute, adjustable to eight positions of discharge
Removable straight pin holding pump sleeve firmly to motor shaft and held in place by water slinger

is protected at impeller end by bronze sleeve extending beyond packing gland. Impeller is single-suction inclosed type with suction side facing motor. Sizes range from 1½ to 4 in., with capacities up to 700 g.p.m. and heads up to 75 and 85 ft. at 1,750 r.p.m.

Pennsylvania Pump & Compressor Co., Easton, Pa.

Centrifugal Pumps

This self-contained automatically primed centrifugal pumping unit comprises an electrically driven high-efficiency ball-bearing centrifugal pump, mounted with its motor on a fabricated-steel bedplate, to-



gether with a Monobloc priming unit of the wet-vacuum type, controlled by an electric pressure switch. Priming pump, or evacuator, is an adaptation of the "Hytor" pump, licensed to Worthington. Units available with Worthington Type R, U, L and F centrifugal pumps up to No. 6 size, and shortly with any type or size of Worthington centrifugal.

Worthington Pump & Machinery Corp., Harrison, N. J.

Stock Pumps

Primarily for handling pulp and paper stock, this centrifugal pump is adaptable for handling other liquids having solids in suspension. Casings and front and back heads are split diagonally on pumps of 3-in. size and above to permit removal of rotating member and linings without disturbing piping. Illustrated is pump arranged for direct drive. Self-cleaning impellers used may be varied to suit conditions.

Warren Steam Pump Co., Inc., Warren, Mass.

Improved Horizontal Duplex Steam Pumps for Oil

Designed and fitted for handling cold or hot oils and gasoline, this improved line of horizontal steam pumps is built in three types—valve plate, turret and pot valve. Stainless steel drop-forged valve service and submerged-piston construction used. Valve plate type units handle cold oils up to 300 deg. F., and 5,000 S.U.S. viscosity. Hot oil service (above 350 deg. F.). Capacities from 40 to 320 g.p.m. at pressures to 150 lb. per sq.in., and from 20 to 240 g.p.m. for pressures up to 350 lb. per sq.in. Turret-type pumps for cold oil service up to 150 to 840 g.p.m. for pressures to 75 lb. per sq.in., and with capacities of 100 to 500 g.p.m. for pressures up to 200 lb. per sq.in. Pot-valve pumps in two designs: For pressures up to 750 lb per sq.in. with capacities of 35 to 350 g.p.m., they have poppet valve service and cast-steel liquid ends with removable Ni-Resist liners. For pressures to 500 lb. per sq.in. and capacities of 140 to 1,800 g.p.m., cylinders are cast steel.

Worthington Pump & Machinery Corp., Harrison, N. J.

Motored Centrifugal Pumps

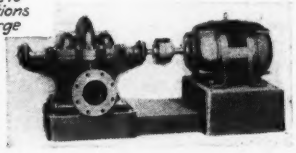
Type MUE (end suction) and MUI (inside suction) single stage, single-suction, centrifugal pump motor units are combinations of centrifugal pump integral with its driving motor. Capacities from 5 to 450 gal. per min. at heads as high as 120 ft. Unit provides exceptional flexibility. Motors ranging from ¾ to 10 hp. are adaptable, operating at speeds of 1,750 and 3,500 r.p.m. Sizes of discharge, 1 to 3 in.

American Steam Pump Co., Battle Creek, Mich.

Non-Clogging Centrifugal Pump

This non-clogging centrifugal pump for handling pulp and similar material has suction nozzle, impeller and pump passages of special form. Various impellers available. Balance of end thrust, adequate support for shaft, convenience of access to pump interior, and economy of maintenance achieved in redesign.

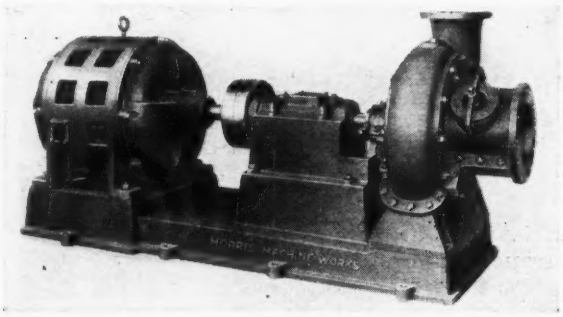
Morris Machine Works, Baldwinsville, N. Y.

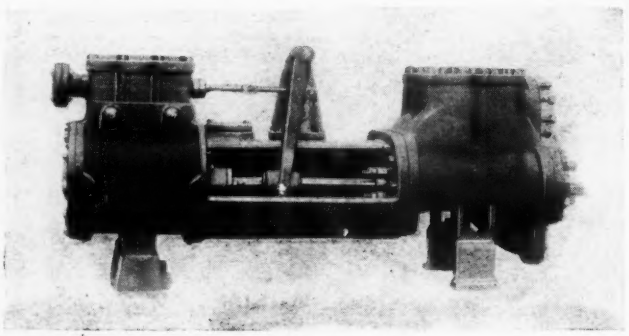


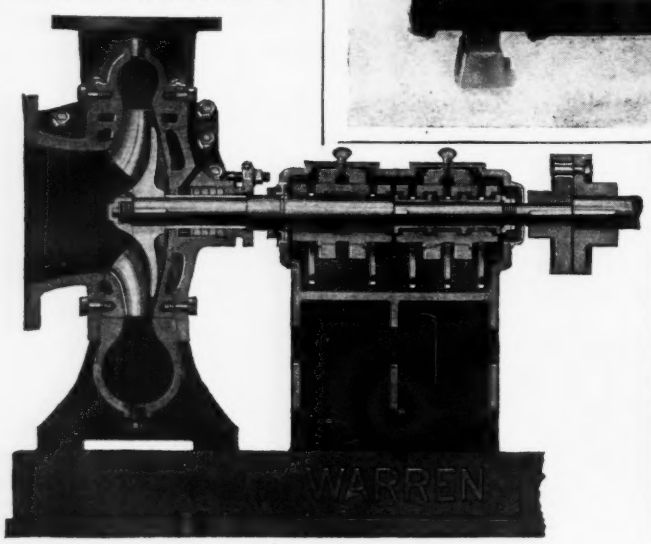
Centrifugal Pump of Improved Design

Fig. 5803 centrifugal pumps are of split case design with streamlining of flow, both in impeller and casing, to avoid cavitation. Pump designed for wide ranges of suction and discharge conditions. Mechanical features include clogless ball bearing element, removable without disturbing alignment or introducing dirt into bearing housing, improved stuffing boxes and wearing rings, improved methods of locking rings to prevent rotation.

Fairbanks-Morse & Co., 900 S. Wabash Ave., Chicago, Ill.



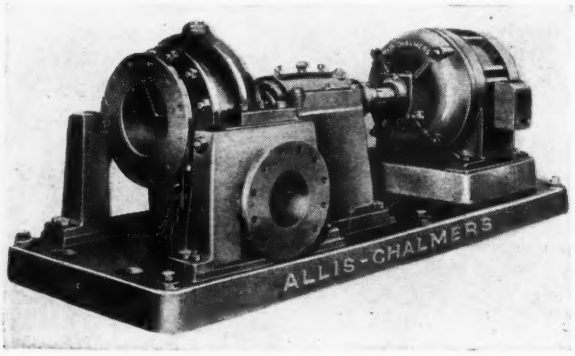


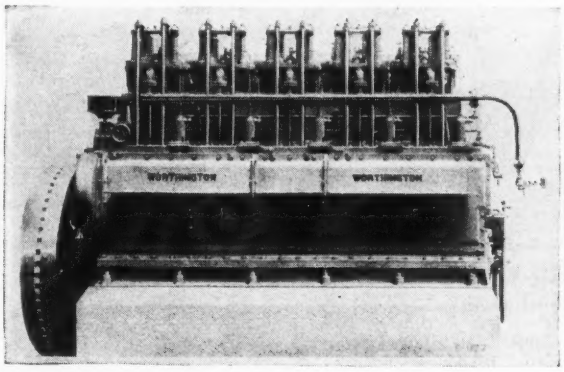


Centrifugal Pumps for Hot or Cold Acids

Type SSA pump of single-suction type has chrome-steel parts coming in contact with acids. Casing supported on horizontal centerline by brackets, and also keyed on vertical centerline underneath water-cooled stuffing box to insure uniform expansion. Rotating element, including self-aligning, anti-friction, bearings and flexible coupling, can be removed through suction end of pump without disconnecting discharge piping or casing brackets or disturbing motor.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

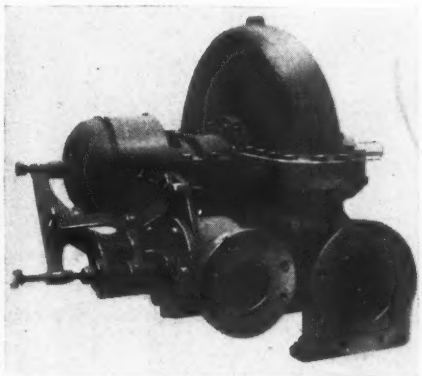




Four-Cycle Direct-Injection Diesel Engines

Covering power requirements from 50 to 1,000 hp. in two to eight-cylinder units, this improved line of four-cycle direct-injection moderate speed diesels has these features: Individual fuel pumps for each cylinder, fuel lines of equal length, hydraulic control of fuel injection; individual air starting pilot valves control admission of starting air to each cylinder. Can be converted to operation on manufactured or natural gas.

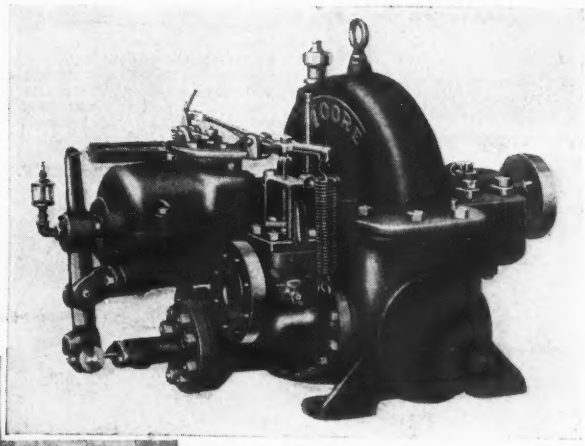
Worthington Pump & Machinery Corp., Harrison, N. J.



Mechanical-Drive Steam Turbine

A new mechanical-drive non-condensing steam turbine for driving centrifugal pumps, fans and other rotating equipment at speeds from 1,200 to 4,000 r.p.m., is available up to 250 hp. under suitable steam conditions. Single-stage, with two rows of revolving buckets. Wheel casing split horizontally to allow access to internal parts, and steam and exhaust pipes are connected to lower half. Centrifugal governor, with weights pivoting on knife edges, operates with little friction and provides proper speed regulation. Independent emergency governor included.

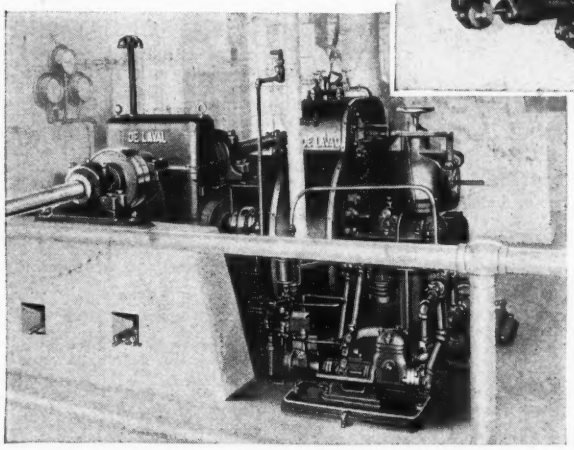
General Electric Co., Schenectady, N. Y.



Small Turbine With Features of Large Units

In sizes up to 60 hp., Type U2RA has all essentials of larger turbines, such as horizontally split casing, carbon packing, emergency overspeed governor with independent trip valve, hardened tool-steel governor wearing parts, babbitted bronze-backed split bearings, water-cooled bearing cases, stainless steel governor valve and valve seats, heavy blading of stainless steel or nickel steel, and auxiliary nozzles for overload. Of cast-iron construction for moderate steam pressures and of all steel with centerline support for steam pressures up to 600 lb. and temperatures to 800 deg.

Moore Steam Turbine Corp., Wellsville, N. Y.



Variable-Speed Governor for Steam Turbine Drives

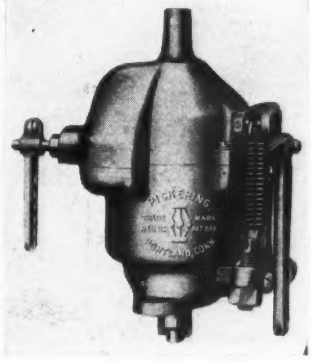
Mechanical variable-speed governor, positively driven through gears from turbine shaft. Acts directly on speed control valve. Shown applied in photo. Speed of gear shaft may be regulated by means of small handwheel at top of governor casing, an indicator below showing speed of driven machine. Adjustments up to 16 to 1 are possible. Can operate at turbine or by remote control.

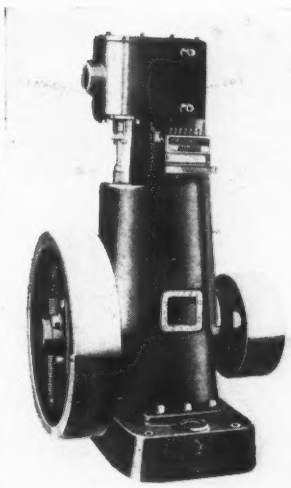
DeLaval Steam Turbine Co., Trenton, N. J.

Governors for Internal-Combustion Engines

In addition to its standard line of steam governors, Pickering G. P. and G. P., Jr., models are introduced. G. P. (illustrated), is designed for vertical mounting, especially for gas engines of medium and large sizes, and has recently been adapted for smaller diesels. Has practically no wearing parts, and lubrication is accomplished either by splash or feed from engine. Provision for remote control. Unit may also be obtained for constant speed. G. P., Jr., is designed for horizontal position.

Pickering Governor Co., Portland, Conn.

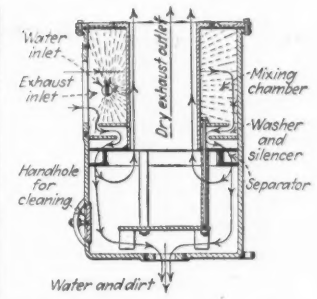




Steam Engine

Troy-Engberg Type E engines now have a new watershed partition between cylinder and crankcase. No part of it comes in contact with the piston rod. Special drains provided from piston rod and valve stem stuffing boxes to prevent water from cylinder getting into oil reservoir in engine base. Engines available with either flat or piston valve on 10-in. stroke size; both types of valves will soon be available on all sizes. Manufacturer will introduce a 12-in. stroke Type E vertical engine which will have a rating of 160 b. hp. at 300 r.p.m. for full load, 24-hr. service, and speed of 325 r.p.m.

Troy Engine & Machine Co., Troy, Pa.



Exhaust Washer and Silencer

Sizes from 2 to 18 in. available in Maxim Model EW silencers for gas, gasoline and diesel engines. Claimed to quench all sparks, wash exhaust clean of carbon and dirt, and quiet noise without imposing appreciable back-pressure. Materials entirely cast iron. Inlet on side near top, washing water inlet to one side adjacent to exhaust inlet. Exhaust outlet at center of top.

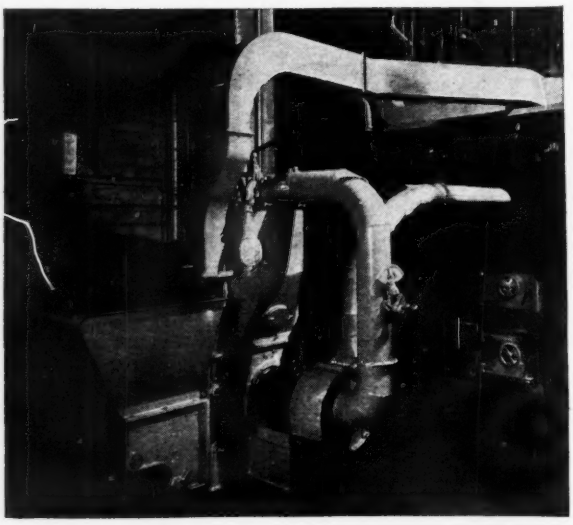
Maxim Silencer Co., Hartford, Conn.

Piston Ring

Seals gap against cylinder wall and ring groove and prevents blow-by. This one-piece "Double-Seal" ring retains design features of two-piece rings of maker. Claimed to improve compression of worn diesel cylinders 10 per cent.

Double Seal Ring Co., Fort Worth, Tex.

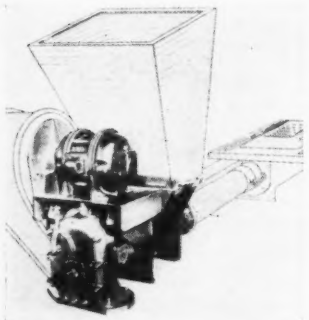
Fuel-Burning Equipment



Small Unit Pulverizer

A-6 "Unipulvo" unit pulverizers, for handling bituminous coal screenings, pitch, lignite, or petroleum coke breeze in capacities from 200-750 lb. per hr. are self-contained and mounted on single bedplate. One 7½-hp. motor provides power for pulverizing and handling air. ⅝-hp. motor actuates fuel-feeding mechanism. Feeder of reciprocating-shoe type, adjustable.

Strong-Scott Mfg. Co., Minneapolis, Minn.



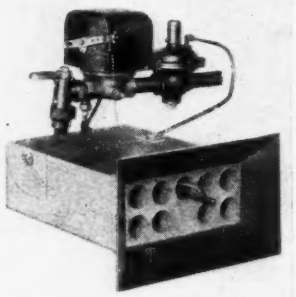
Motorized Gear Drive for Stokers

This complete front-end assembly for stokers is standardized unit which consists of variable-speed stoker drive with base, low-speed flexible coupling with housing, adjustable motor base, and hopper base with clean-out door. It is offered with a variety of motor mounting designs to suit individual applications.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill.

Conversion Burner With Automatic Safety Pilot

Series C conversion burner unit and Mettler improved automatic safety pilot are here combined. Series C triple control unit consists of Mettler gas burner encased in steel jacket provided with air damper to be operated either automatically or by hand, automatic electric motor valve of latest type, safety main and pilot light valves, and



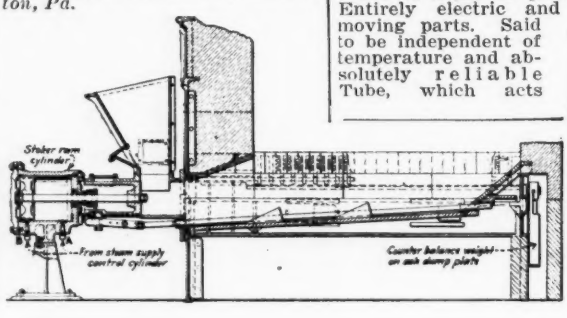
Mettler pilot light with safety switch. Assembled complete with piping and fittings.

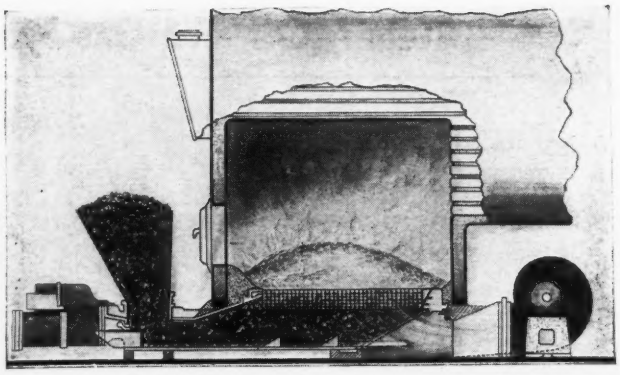
Lee B. Mettler Co., 406 S. Main St., Los Angeles, Calif.

Steam Drive Underfeed Stoker for Bituminous Coals

Type SR steam-driven underfeed stoker is designed for burning coking and non-coking bituminous coal and for use under boilers up to 3,000 sq.ft. of heating surface. Specially designed poppet valve steam control regulator with forced-feed lubrication controls speed of stoker and gives sufficiently wide range of speed. Grate surface made up of replaceable tuyere blocks with staggered mesh to prevent sifting and to give uniform air distribution. Grate bars located between tuyeres, and ash-dumping plates sectional rabbeted design. Adjustable dampers provided for controlling air to retort tuyeres, grate bars and ash-dump plates, thus providing air control over entire fuel bed.

McClave-Brooks Co., Scranton, Pa.

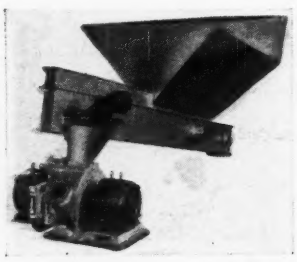




Hydraulic Ram-Type Underfeed Stoker

In "Albany" stokers, hydraulic ram forces fuel into furnace without gears or other complicated parts. Hydraulic power unit, consisting of motor pump and fan, can be placed where most convenient. Motor-driven oil pump on same shaft with forced-draft fan provides pressure which operates hydromotor ram. Hydraulic principle provides an extremely wide range of feed adjustment.

Consolidated Car Heating Co., Inc., Stoker Division, Albany, N. Y.



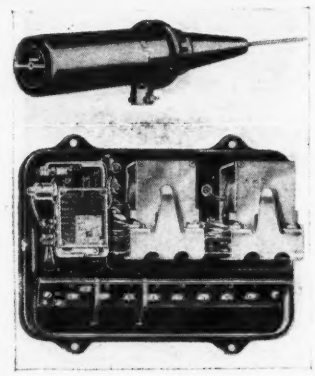
Pulverizing and Direct Firing Unit

This direct firing unit used where equivalent of 8 to 10 lb. of coal or more an hour is required. Claimed quiet in operation without metal-to-metal grinding, and to have but three wearing parts. Operates automatically under control of pressure or temperature switches. Is compact and capable of pulverizing coal so that 85 per cent passes through 200-mesh screen. One unit fires any number of boilers up to its capacity. Sizes vary from 10 in., to 12, 14 and 18-in., the larger sizes burning up to 25 tons per hour. Ten-inch size handles 150 lb. per hour.

Holbeck Direct-Firing Corp., 5151 St. Clair Ave., Cleveland, Ohio.

Automatic Safety Device for Burners

"Protectoglow" provides instant protection against escape of unburned gas or oil in the event of flame or pilot failure. Entirely electric and without moving parts. Said to be independent of temperature and absolutely reliable Tube, which acts



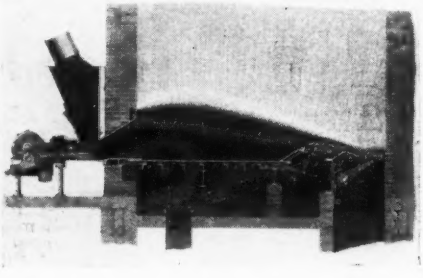
as electrical relay, operates from minute electrical current passing through flame itself. Should flame fail, circuit through flame is broken, shutting off gas or oil flow. In absence of pilot flame, "Protectoglow" will not allow burner to start. "Glo-Relay" used in conjunction with "Protectoglow" serves to operate valves or motor or burner at command of thermostat control switch or "Protectoglow." Self-contained, and available for either constant or intermediate ignition burners.

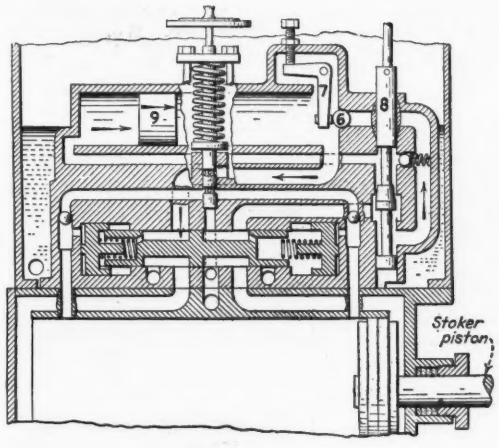
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Multiple-Retort Stoker

Longitudinal side elevation shown of Detroit multiple-retort stoker, in which arrows indicate flow of zoned air to various parts of fuel bed. Inclined fuel bed type with continuous movement of fuel under mechanical control. Closely spaced square retorts have large capacity for effective distillation. Square rams also. Tuyeres plate type. High side-wall tuyeres to prevent clinker adhesion and sectional windboxes on front wall to protect against erosion. Heavy power-operated dumping grates. New design extension moving grates at rear of retorts to insure burning of coke in refuse. For large boilers to be operated continuously at extreme ratings, it is built in various widths and lengths for practically all furnace sizes.

Detroit Stoker Co., General Motors Bldg., Detroit, Mich.

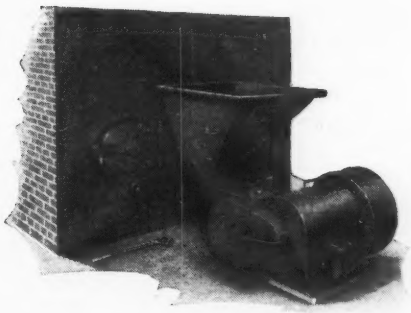




Variable-Feed Control for Stokers

Stott hydraulic stokers, formerly attaining speed reduction by means of oil bypassing a needle valve, now have variable feed control. Accomplished by causing piston to "rest" for a definite interval after each complete out-and-in stroke. Length of interval, under control of operator, can be changed at will to give any desired rate of feed from full feed to as little as 1 or 2 per cent of full, yet action is positive and exact.

Stoker Division, Stott Briquet Co., Inc., St. Paul, Minn.

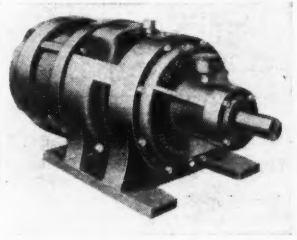


Full Underfeed Stoker

Detroit "LoStoker" is arranged for feed only when needed, being entirely automatic in control. Full underfeed principle introduces fuel by plunger feed below burning zone. Side cleaning preceded by air admission from air chamber to dumping grates in order to burn out combustible is followed by a simple turn of the dump lever to discharge ash. Few setting alterations are required to adapt stoker to boilers already set.

Detroit Stoker Co., General Motors Bldg., Detroit, Mich.

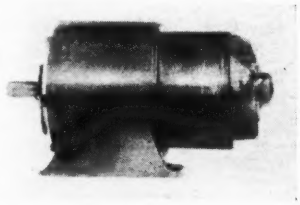
Mechanical Transmissions



Motorized Speed Reducers

Motorized planetary-type speed reducers designed for limited-space applications. Housing for reduction gears integral with base. 34 standard ratios, 4:1 to 240:1. Sizes from ¼ to 30 hp.

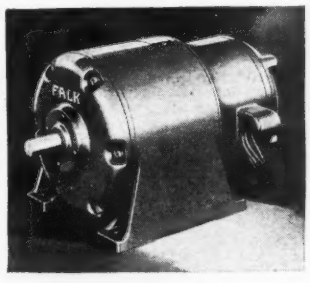
Gears & Forgings, Inc., Cleveland, Ohio.



Motorized Speed Reducers

High efficiency and combination with practically any type of motor are features of this motor-reducer unit. Minimum number of rotating and wearing parts gives efficiencies as high as 97 per cent. Precision gears and pinions. Integral style shown, in which motor endbell is removed and gear casing close coupled. Flexible style, with motor complete mounted on gear casing, is furnished for splash-proof or other protected type of motor. Special motor characteristics as desired. Ratings: ¾ to 75 hp. with output speeds 4 to 400 r.p.m.

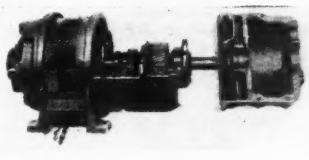
Louis Allis Co., Milwaukee, Wis.



Motor-Reducer

Three styles. Gear housing supports motor. In integral type, motor end bell removed and motor close-coupled through bayonet-type joint to gear case. In flexible type, round frame-type motor used and end bell retained. In all-motor type, any standard horizontal motor may be used, being connected through Falk flexible coupling to reducer housing. Integral illustrated. All three types available in hp. from ¾ to 75, with ratios from 4.6 to 288. Non-planetary, helical-type gears used with over-size ball bearing. Efficiency claimed minimum 97 per cent.

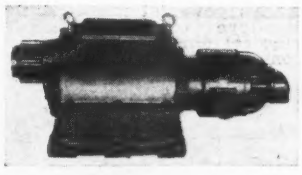
Falk Corp., Milwaukee, Wis.



Gearmotors

Type CS general all-purpose induction motor and double-reduction, non-planetary helical-gear speed reducer built into one-piece motor frame. Gearmotors in sizes from ½ to 15 hp., with outputs ranging from 69 to 1,500 r.p.m.

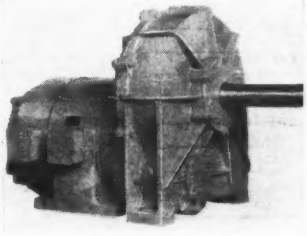
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Motorized Speed Reducer

Totally inclosed triple-reduction unit (shown) has speed ratio of 312.2-1. Motor shaft (extends into reducer housing) operates at 1,165 r.p.m., and low-speed shaft at 4.75 r.p.m. Roller bearings and continuous-tooth herringbone gears used. Gears run in oil. Tabulated ratings allow for 100 per cent momentary overloads.

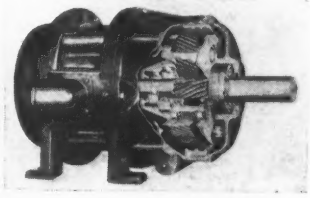
Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill.



Motors with Self-Contained Speed Reducer or Increaser

"Slo-Speed" motor and reduction gears form self-contained unit, with speed reduction affected by inclosed single, double and triple helical and herringbone gears. Stub-tooth gears of special chrome nickel alloy and carbon steel. Anti-friction ball and roller bearings. Available on 3-phase, squirrel-cage, slip-ring, high-torque, 2-, 3- or 4-speed motors, special and single phase. Can be furnished with motor shaft extended on opposite end, thus providing one low- and one high-speed drive, and geared heads can be put on both ends to provide two slow and different speeds if desired. Speed ratios from 3:1 to 130:1.

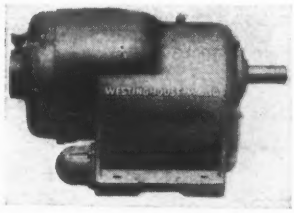
Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles, Calif.



Gearmotors

Normal-speed motor combined with built-in, internal-helical planetary-gear speed reducer. Permits wide choice of output speeds. Available with either flanged or vertical mountings; also with special electrical characteristics or mechanical features. A.C. polyphase, squirrel-cage and wound-rotor motors available in ratings up to 75 hp., single phase to 5 hp., d.c. to 7½ hp. Speeds down to 13 r.p.m.

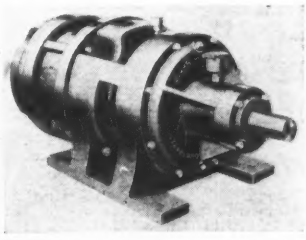
General Electric Co., Schenectady, N. Y.



Gear Motor Units

Westinghouse-Wood units obtainable to give 900 to 60 r.p.m. on out-going shaft using 1,800-r.p.m. motor, or down to 30 r.p.m. using 900-r.p.m. motor. Slow-speed shaft can be had on one end of motor and standard-speed shaft at other. Motors furnished in polyphase, single-phase or d.c. types, ½ to 7½ hp.

H. C. Wood Machine Works, 514 Bryant St., San Francisco, Calif.



Planetary-Type Motorized Speed Reducer

Planetary reduction gear built integral with motor to minimize space required. Motor shaft supported by ball bearings. 34 standard ratios from 4:1 to 240:1 in sizes from ¼ to 30 hp.

Gears & Forgings Inc., Cleveland, Ohio.

Motor-Reducer

"MotoReduceR" combination horizontal motor and speed reducer unit solid, compact. Designed to avoid misalignment of

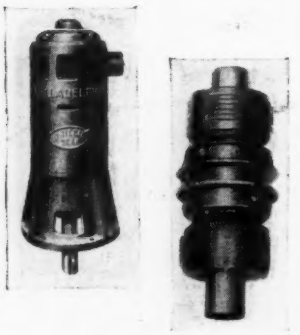
parts. Available in single, double and triple types with ratios up to 450 to 1, and with standard open type or totally inclosed fan-cooled motors, polyphase and single-phase. Also available with d.c. motors up to 10 hp.

Philadelphia Gear Works, Inc., Philadelphia, Pa.

Vertical Motoreducer

"MotoReduceR" is a compact reduction unit for agitators, mixers and other vertical drive. Minimum head room required, and necessity of providing structural supports avoided. Motor- and gear-operated, and self-contained in one housing. Gears heat-treated nickel steel with helical cut teeth. Slow-speed shaft Timken mounted. Available in single, double and triple types at ratios up to 450:1, with standard open type or totally inclosed fan-cooled motors, polyphase and single-phase. Also available with d.c. motors up to 10 hp.

Philadelphia Gear Works, Philadelphia, Pa.



Clutches

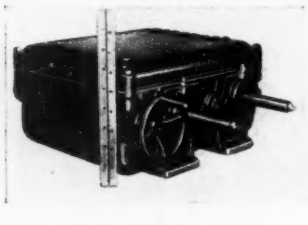
"Pullmore" multiple-disk friction drive unit made in six standard sizes, single or double, from ¾ to 2¼-in. shaft diameters and 2-25 hp. at 500 r.p.m.

Morse Chain Co., Ithaca, N. Y.

Variable-Speed Transmission

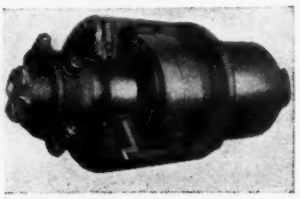
Size 106 is company's smallest variable-speed transmission and is of fully inclosed type. Has capacity of ¼ or ½-hp. motor with maximum speed range of 6 to 1. May be completely lubricated, belt tension adjusted, etc., without removing cover, or even stopping operation. All working parts sealed against abrasive liquids, steam, etc. All sizes up to 15 hp.

Lewellen Mfg. Co., Columbus, Ind.



Disk-Actuated Spiral Friction Cut-Off Coupling

Small diameter and shaft space requirements, high-speed operation, power transmission in ratio to speed, full enclosure, dust-proof construction, smooth exterior, single-point adjustment, and availability with

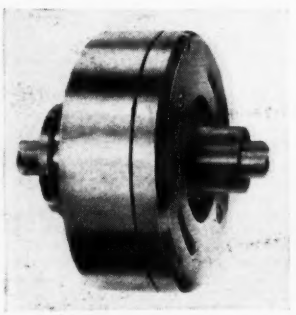


either dry or lubricated friction surfaces. Driving mechanism consists of spiral band contracting on a driving hub, band being actuated by flat asbestos-faced friction disk. Power is transmitted by spiral band, friction disk only contracts spiral. Shifter sleeve cone type. Three sizes, transmitting 3, 10 or 18 hp. Company also manufactures similar pulley clutch.

Kinney Mfg. Co., 3541 Washington St., Boston, Mass.

Magnetic Friction-Type Clutch

This powerful magnetic friction-type clutch of smaller physical dimension is of simple construction, with contact faces on both sides of a spring disk



which are squeezed between magnet and armature elements when coil is energized. Provisions for adjustment for wear. Clutch available with or without ball bearings between hubs. Coils form-wound and vacuum-pressure-impregnated. Company also has single-spring disk clutch following same general construction but with three friction contact faces.

Dings Magnetic Separator Co., 333 Smith St., Milwaukee, Wis.

V-Groove Pulley Drive

"Day-Steel" single and multiple V-groove pulleys for use with Dayton cog belts, for ratings of 7½ hp. and below. They are heavy-gage pressed steel, welded at rim and at web, and assembled with a new design hub.

Dayton Rubber Mfg. Co.

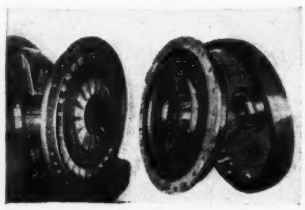
Steel-Back Bronze Bushings

"Detrolined" bushing stock is seamless steel tubing lined with fused-in bearing metal. Furnished in standard sizes 12 in. in length. Special lengths up to 3 ft. available, as is engineering service. Has less than 50 per cent expansion of bronze, requires only 0.015 in. per surface to finish and withstands force fit.

Detroit Seamless Steel Tubes Co., Detroit, Mich.

Hydraulic Coupling

This hydraulic coupling, for use between fans and motors, eliminates constant-speed disadvantage of squirrel-cage motors. Coupling gives infinite number of fan speeds, from motor speed down to about 20 per cent. Motor can be started under practically no-load conditions. Three

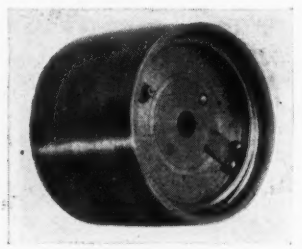


essential elements include impeller on driving shaft, runner on driven shaft, and working fluid. Introduced by Hydraulic Couplings, Inc. Sold by:

American Blower Corp., Detroit, Mich.

Clutch

Ramsey-Pulvis clutches can be made as part of driving member. Any capacity up to 400-hp., 200-r.p.m. Pulvis principle is gradual transmission of power by centrifugal packing of

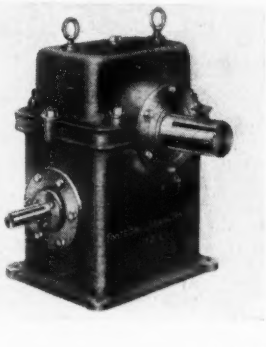


hardened steel shot against driving and driven elements of clutch.

Ramsey Chain Co., Albany, N. Y.

Reduction Gear

Foote Size 5-HG reduction units are built in five types and with a wide range of speed ratios from 3.5 to 1 to 3,000 to 1. Fills gap between 4-HG and 6-HG units. All shafts heat-treated alloy steel, and

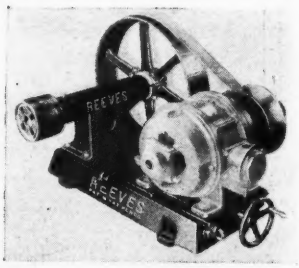


radial ball and tapered roller bearings used. Worm and shaft machined from single nickel steel forging and gear hobbed from special bronze. Lubrication by splash. Unit transmits up to 14 hp. continuous duty.

Foote Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

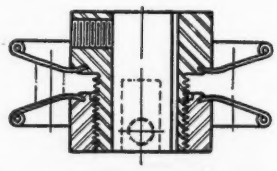
Speed-Control Unit

Adaptation of Reeves variable-speed motor pulley unit. When handwheel is turned, motor and adjustable pulley are retracted



from large pulley, causing belt to assume smaller diameters. Unit, in seven sizes, available from fractional to 7½ hp.

Reeves Pulley Co., Columbus, Ind.



Variable Pitch-Diameter Steel Sheave

Developed originally to meet demands for a variable-speed sheave on small fans and blowers for air-conditioning units but applicable to general service, this line of Texsteel sheaves obtains variable diameter by adjusting two bevel plates shown. Speed variations of 35 per cent.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Improved Short-Center Drive

Rockwood short-center drives now have bases with adjustable arms for motor and drive adaptable to all kinds of motors for 25, 50 or 60 cycles, single or polyphase, a.c. or d.c. Adjustable arms provide means for securing correct belt tension. List of drives in stock increased to 100-hp., 1,800-r.p.m.

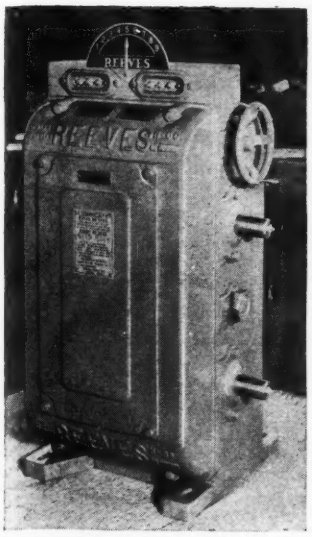
Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind.

Oilless Bearings

"Parock" graphite-impregnated rubber bearings can be obtained as complete bearings

or in solid square or round bars from 1 in. up to 36 in. O.D. in ¼-in. increments. Maximum atmospheric and bearing temperature is 250 deg. F., thickness of bearing under ¾ in. I.D. is ⅛ in., over is ¼ in. Weight of material, 1 oz. per cu.in.

The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.



Vertical Inclosed Transmission

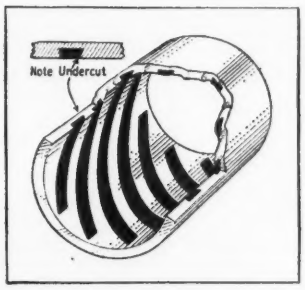
Standard internal operating parts of Reeves transmission incorporated. Particularly adapted to certain standard equipment installations and to installations requiring less floor space for speed control units. Dust-proof, oil-tight, cast-iron cage incloses all operating parts. May be equipped with electric remote, electric automatic, and mechanical automatic controls and with motors, motor bases and other accessories. Motor base adjustable to tighten drive and to suit various motors. Ten sizes; speed ratios of from 2:1 to 8:1.

Reeves Pulley Co., Columbus, Ind.

Oil Seal for Anti-Friction Bearings

"Aetna" oil seal for anti-friction bearings consists of four parts forming self-contained unit. Outer steel shell houses seal cushion, pressure plate and steel retainer. Seal cushion is of specially treated cork which expands and contracts laterally with changing temperature of shaft or lubricant. Cork is non-hygroscopic and impervious, and has great resiliency and low friction coefficient. Seal available in sizes from ½ in. inside diameter and up.

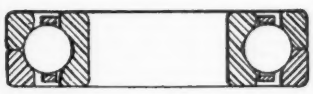
Aetna Ball Bearing Mfg. Co., 4600 Schubert Ave., Chicago, Ill.



Oilless Bearing

Designed for sliding or oscillating motion with axis either vertical or horizontal, this spiral type oilless bearing will operate at speeds up to 2,500 r.p.m., depending upon load, and at temperature not above 400 deg. F.

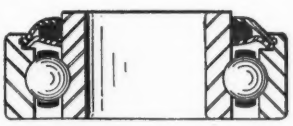
E. A. Williams & Son, Inc., 111 Plymouth St., Jersey City, N. J.



Duplex Ball Bearings

CD duplex double angular contact ball bearings meet need for bearing of high thrust carrying capacity in either direction and with width same as standard single-row ball bearing. Light, medium and heavy metric series. Should be used only where thrust load exceeds radial load.

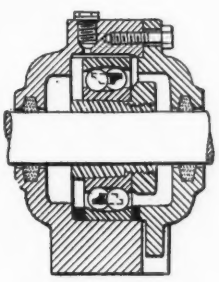
Norma - Hoffman Bearings Corp., Stamford, Conn.



Improved Ball Bearings With Oil Seal

Oil retainer, or seal, is composed of two circular plates wedged together into a groove in outer ring of bearing. Contained between these two circular plates is wiper or ring of felt that makes contact within a bearing, as illustrated, or with a shaft. Felt wiper or ring forms oil-stop that retains lubricant within bearing. Plate construction is such that there is constant pressure against felt ring between plate members.

Standard Steel & Bearings, Inc., Plainville, Conn.



Pulley Block Pedestals

"Lup" series of unit pedestals for pulley blocks for average industrial applications are equipped with double-row self-aligning ball bearings with adapter sleeves. Sizes to fit standard shafting in nominal inch as well as sixteenth diameters from 1 1/16 in. up to 3½ in. Pedestals have large volume for lubricant and are fitted with protecting felt seals and fittings. Distance pieces furnished where bearings are to be clamped.

Norma - Hoffman Bearings Corp., Stamford, Conn.

Compensated Rubber Belt

"Compensated" belts are designed to compensate within their own structural members to permit low-tension operation. Claimed to develop two times rated horsepower of usual rubber belt with one-half tension, slip and creep. Has specially treated pulley surface with double coefficient of friction of normal rubber belt. Will run on very small pulleys. Equalizing tension on outer and inner duck plies avoids usual tendency for fasteners to work out. Will stand 100 per cent overload with only 2.75 per cent slip and creep.

Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., Passaic, N. J.

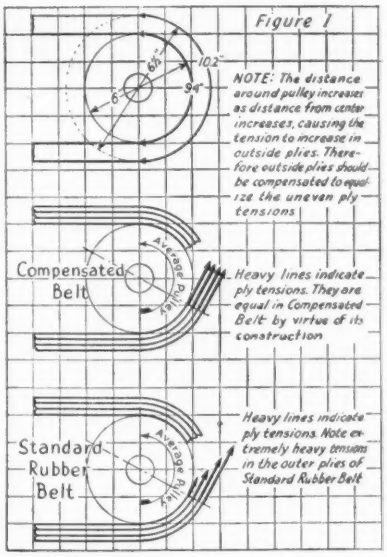


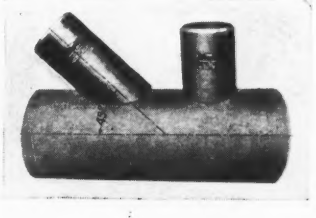
Figure 1
6⅝"
10.2"
6"
9.4"
NOTE: The distance around pulley increases as distance from center increases, causing the tension to increase in outside plies. Therefore outside plies should be compensated to equalize the uneven ply tensions
Compensated Belt
Average Pulley
Heavy lines indicate ply tensions. They are equal in Compensated Belt by virtue of its construction
Standard Rubber Belt
Average Pulley
Heavy lines indicate ply tensions. Note extremely heavy tensions in the outer plies of Standard Rubber Belt

Transmission Belting

"Highflex Junior" belting is built up of a greater number of plies of a specially woven fabric in widths 6 in. and under, rubber impregnated. Special cement, tie gum and automatically controlled portable electric vulcanizers, together with necessary template and hand tools are provided for permitting user to make endless belts in his own plant.

B. F. Goodrich Rubber Co., Akron, Ohio.

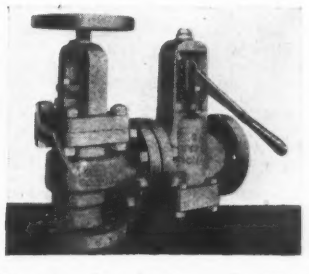
Piping, Valves and Fittings



Shaped Welding Nipples

Shaped welding nipples are claimed to eliminate all templates when saddling one pipe upon another. Both shaped and square nipple ends are beveled for welding. Both 90-deg. and 45-deg. types are of standard or heavy wrought steel pipe and wrought iron pipe; sizes from 1¼-12 in. Specials with forged laps of flanges or in other angles, lengths and sizes.

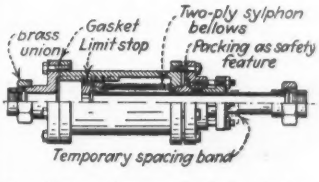
Midwest Piping & Supply Co., Inc., St. Louis, Mo.



Tandem Boiler Blow-Off Valves

Type D plug, and Type E angle tandem boiler blow-off valves embody same principles as Type C valve. "Cochrome" bodies for pressures up to 250 lb. and cast-steel bodies for pressures up to 400 lb. Either may be used independently to supplement any existing valve, or together in new service. Plug valve is lifted clear of seat before turning begins. In Type E, wire drawing and scoring of disk and seat avoided by providing underneath disk proper a close-fitting skirt, which fills seat opening and prevents appreciable flow until disk has been raised clear of seat. Disk and seat of Nitralloy.

Cochrane Corp., 17th & Clearfield Sts., Philadelphia, Pa.

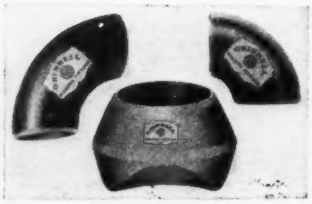


Packless Expansion Joint

"Sylphon" packless expansion joint No. 111 uses packing merely as a safety feature to offset fears of those still skepti-

cal about metal bellows expansion members. Metal bellows is two-ply, and limit stops allow total travel of 1½ in. for expansion and contraction of 80 ft. of brass pipe or 120 ft. of wrought iron pipe with variations of 20 to 180 deg. F. Pressures up to 150 lb. per sq.in.

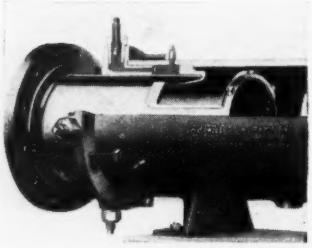
Fulton Sylphon Co., Knoxville, Tenn.



Welding Fittings

Grinnell welding outlets and threaded outlets are stock fittings designed for pipe welding to make tees, side outlet tees, crosses, etc., under practically all pressures and services. Heavy external reinforcements provide strength and dissipate excess heat when welding, preventing shrinkage and distortion.

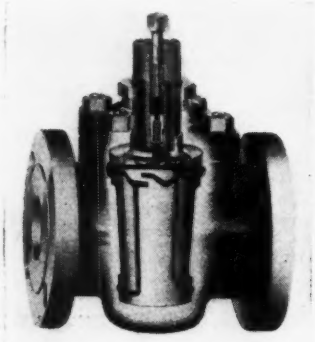
Grinnell Co., Inc., 277 W. Exchange St., Providence, R. I.



Gun-Packed Expansion Joint

"Gun-Pakt" expansion joints utilize a screw "gun" to force plastic packing into expansion sleeve joints. Packing composed principally of long-fiber asbestos, graphite and inorganic filler. Four guns mounted to pack each gland have deflector vanes below them so that pressure will not blow packing out when plunger is removed to insert more packing. All pressures and temperatures (thus far to 400 deg. F.).

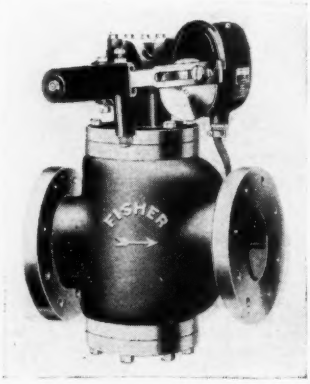
Yarnall-Waring Co., Mermaid Ave., Philadelphia, Pa.



Lubricated Plug Valves

Plugs of these valves are held in place mechanically so that lubricant only affects pressure-type seal instead of lifting. Lubrication system in valve body provides complete seal at plug top, thus eliminating need for stuffing box.

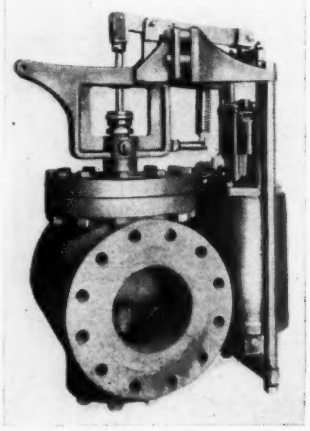
Crane Co., 836 S. Michigan Ave., Chicago, Ill.



Motorized Valves

Illustrated is Fisher Type 5071C motorized valve, one of a line. Controls temperature in hot water or steam systems accurately and remotely. Several types of valve bodies in bronze, semi-steel, cast steel, with Duromite bronze trimming and Ni-Resist stainless iron or stainless steel valve trimming. Available for practically all operating temperatures and pressures and to suit any electrical circuit.

Fisher Governor Co., Marshalltown, Ia.



Thrustor-Operated Valve

For centralized remote control of gases or liquids under pressure, this Thrustor-operated valve is available in sizes from 2 to 12 in., for 125 to 600 lb. pressure. Thrustor applies pressure to valve to open or close it, and spring returns the Thrustor to its original position. Operating cylinder readily adjustable. No overload protection necessary. No limit switches necessary.

General Electric Co., Schenectady, N. Y.

Solenoid-Operated Gate Valve

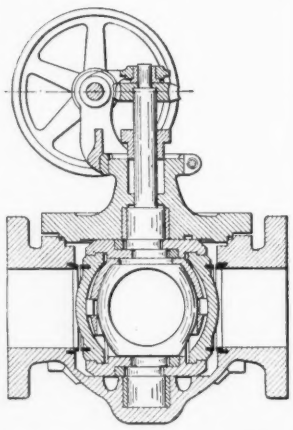
Centralized control of steam, water and other process lines is made possible by this gate valve for steam pressures up to 125 lb. and water pressures up to 150 lb. Of relay servomotor type, with small solenoid

actuating hydraulic motor. Lever shows position of valve and can be used for manual operation when necessary. Valves arranged to open to full pipe size and to operate at any desired speed.

Ruggles-Klingemann Mfg. Co., 30 Balcomb St., Salem, Mass.

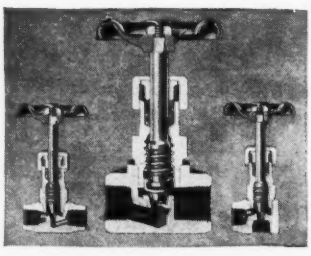
Rotary Valve

A.R.G. rotary valve claimed to eliminate disadvantages of globe and gate valves for larger pipe sizes through enlarging stem in center of body, and providing it with bore equal to internal diameter of valve, thus forming rotary disk holder.



Stem is non-rising, permitting lowered over-all height. Worm-wheel drive. Valves either cast iron or steel, seats and disk rings nickel alloy. Extremely rapid operation—20 sec. to close, 50 to open.

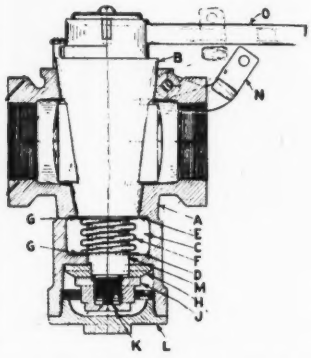
Allgemaine Rohrleitung Aktiengesellschaft, Düsseldorf (Germany) Scliessfach 363.



Bar Stock Valves

For high strength and close control ¾- and 1-in. steel globe valves have stainless steel renewable slip-on disks and screw-in seats. Smaller valves, both globe and angle, have integral seats and disks. Working pressures, 4,000 lb. at 150 deg. F., 600 lb. at 500 deg. F. Other valves are: bronze globe, angle and cross types for 500 lb. at 150 deg. in sizes up to ½ in. Stainless steel globe and angle types in sizes up to 1 in. and pressures up to 4,000 lb. at 150 deg. F. and 600 lb. at 150 deg. F. Many special designs.

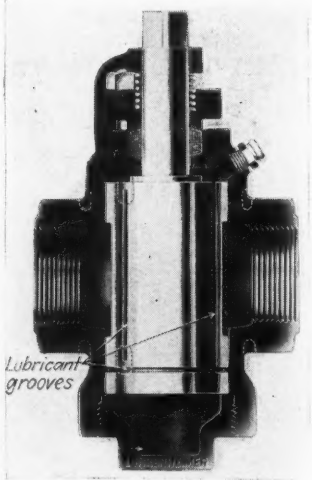
Reading-Pratt & Cady Co., Inc., Bridgeport, Conn.



Rotary Plug Cock Valve

This plug cock valve does not stick or leak, and does not require lubrication. Valve casing *A* is provided with spring chamber *C*, with shoulder or abutment at outer chamber at *D*, spring washer at bottom of plug *B* at *E*. Spring *F* between abutment *D* and plug base washer *E* counteracts binding when plug is turned on seat. *G* is lower spring washer. Key collar *H* on shank prevents adjusting nut *J* from loosening. Screw-locking adjustment at *K*. Other parts: housing cap *L*, plug shank *M*, lever locking device *N* and operating lever *O*.

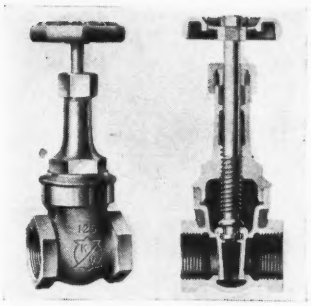
J. E. Swendeman, Inc., 171 Camden St., Boston, Mass.



Lubricated Rotor Valve

"Slaset" valve has lubricant forced into reservoir above closed top of rotor, pressure forcing rotor down as reservoir fills. Pipe line pressure, aided by an external spring, causes rotor to act as booster plunger which forces lubricant into pockets in body and grooves in rotor. Stem and rotor are not integral, stem joint being flexible to permit rotor to seat properly. Screw ends for 150 lb. and flange ends for 125 lb. gas or liquid pressure at 150 deg. F.

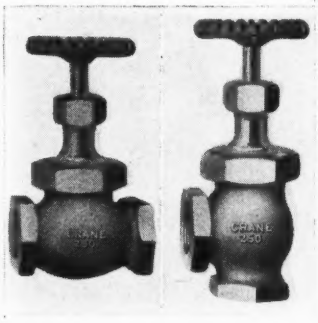
Lunkenheimer Co., Cincinnati, Ohio.



Rising-Stem Bronze Gate Valves

For 125-lb. steam and 175-lb. water pressures, these rising-stem bronze gate valves have same solid wedge disk mechanism as standard Kennedy stationary stem bronze gate valves. Simple mechanism. Flexible connection between disk and stem to prevent binding and springing when valve is closed.

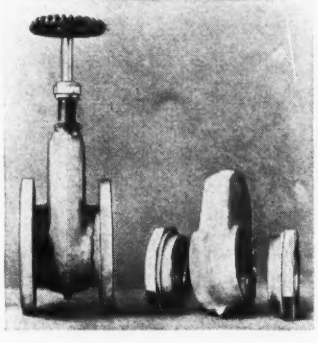
Kennedy Valve Mfg. Co., Elmira, N. Y.



Globe and Angle Valves

These additions to Crane series of globe and angle valves with plug-type seats and disks have brass union bonnets and are for 250 lb. steam service. No. 212-P for globe and No. 214-P for angle are made in sizes from ¼ to 3 in. Plug-type disk provides large area of contact, resistance to wire drawings and tends to overcome foreign matter lodging on seating surfaces.

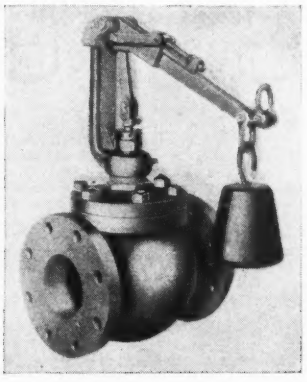
Crane Co., 836 S. Michigan Ave., Chicago, Ill.



Improved Gate Valve

Radical departure from conventional design has decreased weight, provided greater simplicity and interchangeability in this gate valve. Bronze disk is installed through flow passage, doing away entirely with bolted or threaded bonnet. Two sets of opposed threads operate to lift disk twice as fast as stem and with half as many turns. Disk is of self-aligning type. Lapping of seats easily accomplished. Valve very light; 2½-in. size weighs 6 lb. in aluminum and 13 lb. in bronze. Various connection arrangements are available.

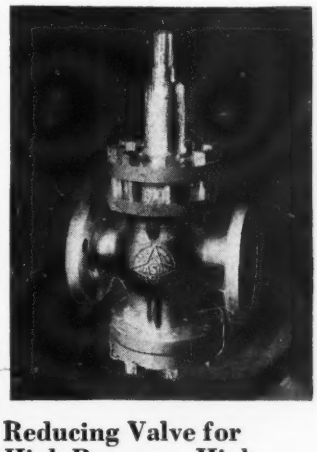
Shand & Jurs Co., 917 Carlton, Berkeley, Calif.



Lever-Operated Control Valves With Additional Port Opening

Lever-operated control valves fitted with parabolic type gradual-opening bevel seats, capable of adjustment for any maximum ual-opening bevel seats, capable sive increment of port opening proportional to travel of controlling mechanism, and used on air, gas, oil, water or steam lines with any standard control device, or in combination with floats direct or pilot-operated for control of liquid levels. Adjustment of port opening to control mechanism travel by adjusting screw on lever. Valve may be used for minimum flow without bypass. Made with bronze body suitable for 300-lb. working pressure, in sizes from ¼ to 2 in., and with cast iron body for 250-lb. pressure from 2½ to 6 in. Valves of special metal also available.

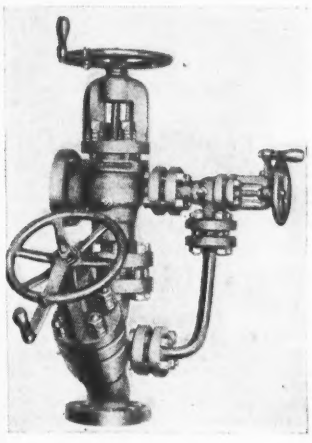
Atlas Valve Co., 282 South St., Newark, N. J.



Reducing Valve for High-Pressure, High-Temperature Service

Designed especially for use on high-temperature service, this reducing valve embodies a new type of valve design to reduce flow turbulence and wire drawing in steam turbines. Body cast of chrome molybdenum steel, and has high tensile strength suitable for initial pressures up to 600 deg. and total temperature of 750 deg. F. Main and auxiliary valves Nitralloy; other moving parts stainless steel, heat-treated.

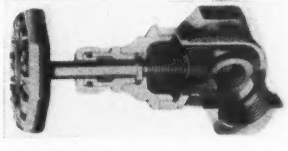
Mason Regulator Co., 1190 Adams St., Boston, Mass.



Triplex High-Pressure Blow-Down Combination

Two main valves are 2½-in. Yarway seatless Type C high-pressure 1,400-lb. valves, one next to the boiler being an angle valve, and outboard valve straightway. To annular space of each valve has been attached flanged nozzle, and to flanged nozzle of angle valve is bolted a 1-in. flange angle valve. Other flange connected by gooseneck to nozzle of straightway valve. This combination recently installed in 1,400-lb. central station for high-pressure service. Blowdown through 1-in. valve.

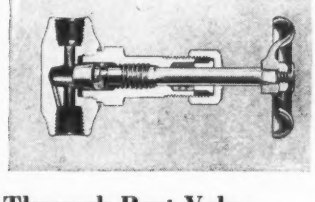
Yarnall-Waring Co., Mermaid Ave., Philadelphia, Pa.



Solid-Wedge Stationary Stem Gate Valve

The standard bronze solid-wedge stationary-stem gate valve has extra large bonnet hexagon placed close to hub face joint where it screws into body. This makes valve more rigid and also assists in removal of bonnet and stem assembly in limited space. Stem engaged with disk for extreme depth to provide large number of contact threads. Stuffing box provided with gland on all sizes and packing rings are molded square section of a composition with high graphite content. Suitable for use on 125-lb. steam pressure and 175-lb. water pressure.

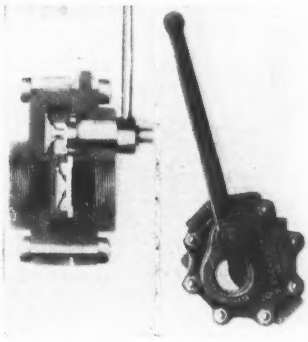
Kennedy Valve Mfg. Co., Elmira, N. Y.



Through Port Valve

Recommended for services where coking and similar troubles are encountered, these valves can be cleaned by running rod through line. Valve turned from carbon steel; stems treated for high-temperature service. Renewable slip-on disk of stainless steel free on stem and non-rotatable. When open, disk is entirely out of passageway. Relief passage permits escape of fluids caught under plug as it closes. Body, bonnet, packing nut and gland Parkerized to protect against corrosion.

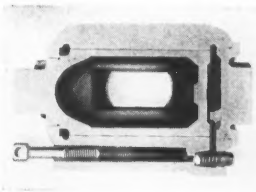
Reading-Pratt & Cady Co., Inc., Bridgeport, Conn.



Improved Quick-Opening Valve

Model W "Everlasting" valve retains principle of passing a disk over outlet port of valve to effect seal, although both disk and post spring are now cone instead of cylindrical units. Operating post now square instead of hex and supplied with new type cushion ring and wearing ring. Available in cast iron, cast steel, bronze or semi-bronze, ¼ to 2-in. sizes will handle pressure to 250 lb.; 2½-in. size, pressure to 150 lb., and larger sizes up to 6 in. for lower pressures.

Everlasting Valve Co., 1 Montgomery St., Jersey City, N. J.



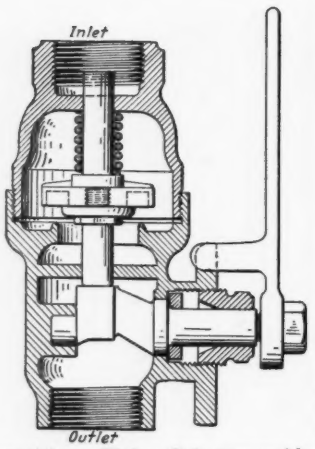
Plug-Type Lubricated Improved Valve

Only seven parts are included in this Milliken valve for pressure work. Originally had movable gland in head, head being held to body by gland bolts. Now made with solid head which avoids glands, bolts, bonnets and stuffing boxes. Face-to-face dimensions of flanged valves same as standard gate valves. Special steel for heavier sizes.

American Car & Foundry Co., 30 Church St., New York, N. Y.

Quick-Opening Compressed Air Valve

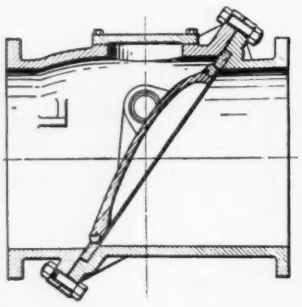
Although designed primarily for use on railway equipment, this compressed air valve has a number of other uses. Designated Murdock 20-C, it is designed for quick opening and closing, stopping at either full-on or full-off. In closed position, disk is held in seat by pressure only, and cam is disengaged from stem. Spring shown on stem of disk is an auxiliary in case valve is installed in horizontal or vertical



position. Valve disk renewable. Valve of red brass fitted with hard bronze camshaft and steel handle. Sizes from ½ to 2 in.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.

Disk Check Valve

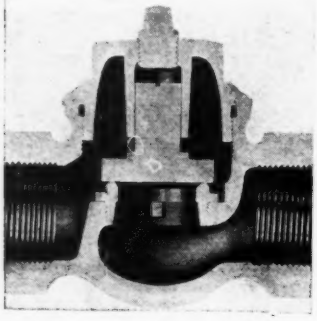
Capable of being used as a stop-valve with slight modification, this check valve consists essentially of a rigid circular disk pivoted within a cylindrical housing. Seats are of circular

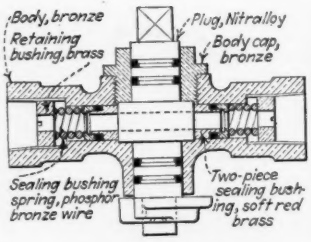


bevel type and disk drops cleanly into contact without rubbing. Disk rotates about fixed pivots offset from seat. Pivots bushed with nitrided steel. Unit claimed to overcome slamming at closing, large losses of head, severe wear on moving parts. Sizes from 3 to 48 in. for any working pressure.
Chapman Valve Mfg. Co., Indian Orchard, Mass.

Check Valve with Renewable Parts

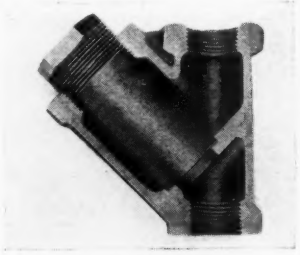
Seats and disks, of any desired material, are arranged to permit regrinding or refacing. Seat may be renewed without taking check from line. Disk ground by screwdriver inserted through top plugged hole, using cap as guide. Sizes ¼-in. to 3-in.; working pressures 0 to 275 lb.
Bundy Steam Trap Co., Nashua, N. H.





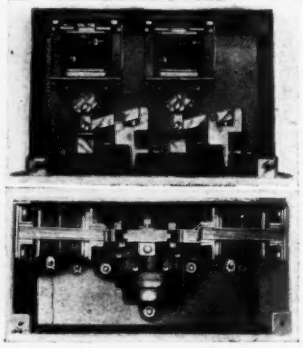
Improved Hydraulic Valves

Yarway hydraulic valves now use 2-piece sealing bushings and cast Nitralloy plugs. Bushing leathers now slipped over one part of bushing, retaining ring being forced against packing ring by spring action. New method of packing plug uses expanding cup leathers instead of ring packing illustrated.
Yarnall-Waring Co., Mermaid Ave., Philadelphia, Pa.



Pipe-Line Strainer

This self-cleaning strainer for installation on return line of systems up to 125 lb. per sq.in. pressure will remove dirt, grit and scale. Self-straining and draining when plug is out or blow-off valve open. Six sizes: ½, ¾, 1 1¼, 1½, and 2-in. pipe.
Jas P. Marsh & Co., 2073 Southport Ave., Chicago, Ill.

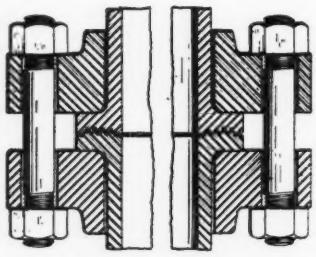


Electrically-Operated Air Valves

Model C (top) furnished in both double and single types for remote control of either double- or single-acting air cylinders. Model D designed for time-cycle operation or remote control of air cylinder. Model E for 4-way control of double-acting air cylinders.
Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago, Ill.

Improved Van Stone Pipe Joint

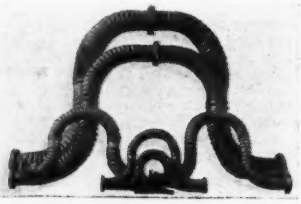
Ability to make tight joint at highest pressure without use of gasket between flanges or welding around outer circumference of



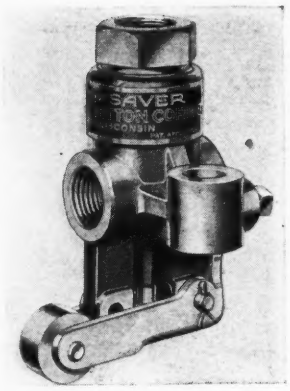
flanges is a feature of this improved Van Stone joint. Tight seating of joint by means of concentric V grooves and rings on flanges. When joint is drawn up, raised rings on one flange press into grooves in other to give steam-tight joint suitable for use with highest pressures and superheat. Joint can be taken apart and put together as often as desired.
American Power Piping Corp., 706 Security Bldg., St. Louis, Mo.

Corrugated Steel Pipe Expansion Bends

"Aiton" corrugating process applied to steel pipe and tubing for expansion bends. Bends give maximum flexibility in

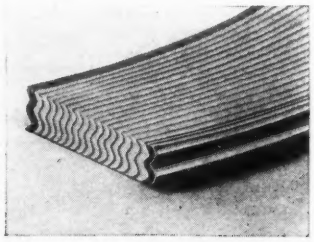


all directions, permitting safe connections in close quarters and where vibration and weaving are factors.
Standard Piping & Fitting Co., 49th & Gray Aves., Philadelphia, Pa.



Air Saver Valve

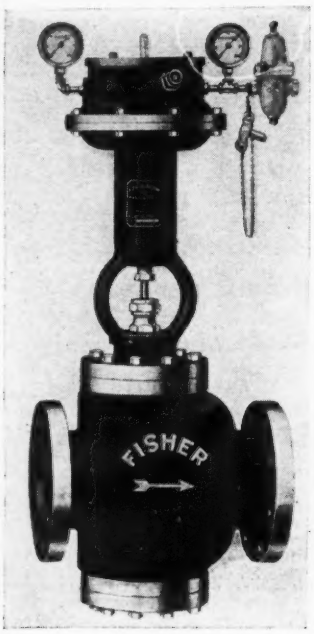
This device supplies automatic, intermittent control of compressed air blasts.
Briggs & Stratton Corp., Milwaukee, Wis.



Combination Metal and Asbestos Gaskets

Garlock "Guardian" gasket is said to give safety against any pressure or temperature, resistance to gases and liquids, tight joints under changing temperature and continued resiliency in service. Made from metal ribbon shaped and wound with intervening layers of asbestos.
Garlock Packing Co., Palmyra, N. Y.

Regulators and Controllers

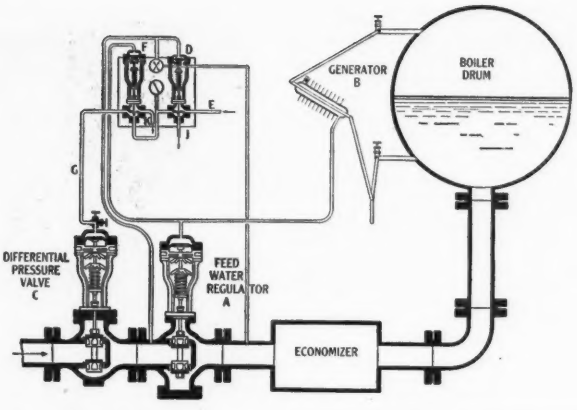


Steam Regulator

Series 4200 Wizard pilot unit, which includes pilot valve as an integral part of main valve top work, utilizes auxiliary air or gas as an operating medium and is suitable for pressure conditions of 5 lb. and up. Converted easily from pressure reducing valve to pressure release valve by simple change of pilot. Furnished complete with small auxiliary regulator shown attached and with pressure gage.
Fisher Governor Co., Marshalltown, Iowa.

Differential Pressure Controllers

Series B have differentials adjustable manually at all times to any value to permit a smaller level regulator to be employed with equal capacity and greater flexibility. Series C units have differential automatically controlled to vary as square of steam demand. This results in rate of boiler feeding being almost synchronized with load.
Mercon Regulator Co., 1 La Salle St., Chicago, Ill.



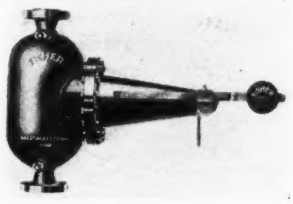
Feed-water Regulator with Differential-Type Master Control

Improved S-C regulator makes use of differential-type master control which is essentially pressure amplifier. Slight fluctuations in differential pressure are magnified, and these enlarged fluctuations are in turn used to operate differential pressure valve. *A* is standard S-C feed-water regulator operated by generator *B*. Pressure drop across valve *A* is maintained constant by controlling valve *C*, which in turn is governed by differential pressure master control valve *D*.

Swartwout Co., 18511 *Euclid Ave., Cleveland, Ohio.*

Liquid Level Controller Float Cage

This drawn-steel controller float cage is for use where float outside of tank or tower is required to operate lever or pilot valve or indicator or switching mechanism. Made of open-hearth steel with T.S. 65,000 lb.



per sq.in. Drop-forged steel flanges at top and bottom of cage and nipple welded on. Bolted flange between body and arm permits removal or inspection of float without removing cage from tank or tower. Suitable for high pressures and temperatures, 610 lb. at 600 deg. F. or 410 lb. at 900 deg. F. Has ball-bearing grease seal stuffing box, stainless steel ball float. Cage stronger and 60 per cent lighter than cast cage. Bulletin 37.

Fisher Governor Co., Marshalltown, Ia.

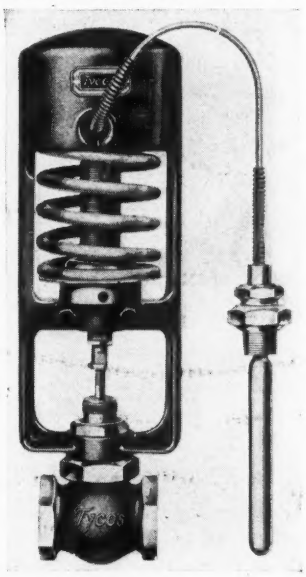
Flow Controllers

Regulators maintain proportional flow of liquids where two liquids do not mix, or, if mixing, do so at process points remote from point of desired control. various items include: constant flow regulators, flow limiting regulators and proportioning regulators for more general applications involving fluid mixing.

Mercon Regulator Co., 1 La Salle St., Chicago, Ill.

Improved Self-Acting Temperature Regulator

Close-control, quick response and sensitivity in "Tycos" self-acting temperature regulator. Valve claimed to move practically simultaneously with temperature change. Improvements in construction of tube system are double seamless bellows, extra heavy wall, copper connection tubing, and stainless steel bulbs of small size, with thin wall.

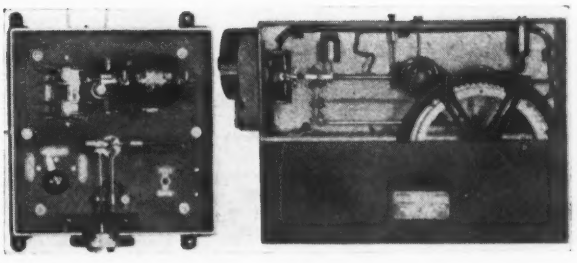


Taylor Instrument Companies, Rochester, N. Y.

Feedwater Regular

Type DA regulator, developed primarily for oil field boilers, is also applicable to some others. It is a single unit installed in vertical feed lines. No brackets or supporting members other than ¾-in. steam and water connections are needed. Expansion tube protected throughout its length by heavy channels bolted to valve body. Tube movement acts directly on valve stem to move disk. Disk and seat stainless steel. Furnished only in 2-in. valves of cast iron or cast steel, complete with 250-lb. pressure standards.

Northern Equipment Co., Erie, Pa.



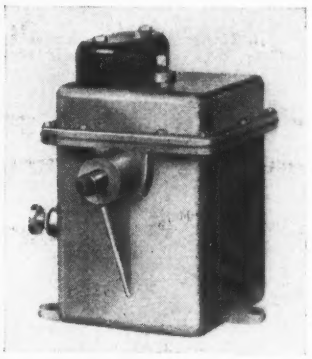
Damper and Furnace Draft Regulators

Junior model small furnace draft regulators (left) control boiler dampers; stoker and fan motor speeds are controlled by automatic pressure regulators (right) functioning from boiler steam pressure. Regulators work on 1-oz. pressure change and will make 16 stops for 1-lb. pressure change or any variation from 1 to 10 lb.

Defender Automatic Regulator Co., St. Louis, Mo.

Adjustable-Speed Damper Controllers

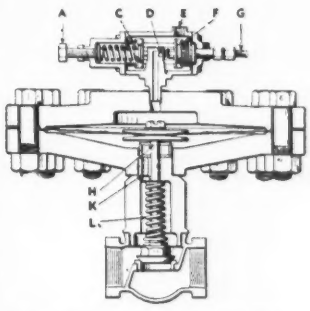
Damper controllers may now be obtained with speed-regulating governors for use with both single- and multiple-louvred dampers in heating, ventilating and air-conditioning systems. Regulating governor, which allows wide speed range, is small reciprocating pump working against variable head set up by pressure necessary to force oil past an orifice at one end of pump cylinder. Speed variation obtained by adjusting this opening. Fractional-horsepower induction motor of shaded-pole type actuates controller and its governor.



Barber-Colman Co., Rockford, Ill.

Steam-Operated Controller

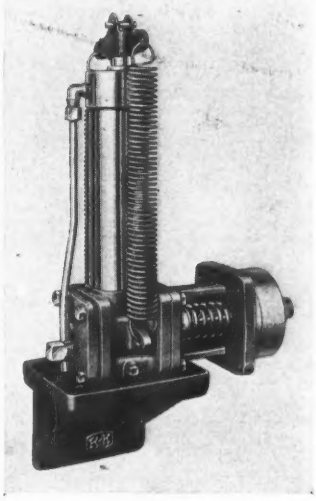
Normal position of steam valve in this controller is closed. Steam enters valve above seat and passes at once into lower diaphragm chamber through opening *K*, pushing diaphragm up and opening steam valve. There is also opening *H* in valve stem, which allows steam to enter upper diaphragm chamber. If steam in upper chamber is not allowed to escape, both chambers will have same pressure, and valve spring *L* will close steam trap. If, however, steam in upper diaphragm chamber is allowed to escape through control port *D*, which has larger opening than *H*, pressure above diaphragm will be less than pressure below, and steam valve will be open. Thermostatic bellows also operates control port *D*, and is a part of usual thermostatic system, which includes connecting tube *C*. *C* is a pressure equalizing bellows. A temperature setting screw, *E*, is connection for control port escapement.



C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.

Hydraulic Damper Regulator

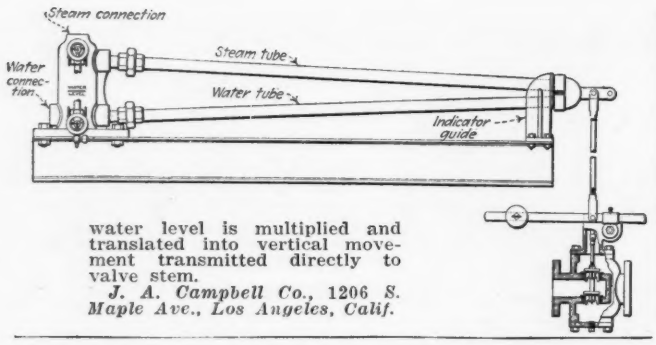
"Midget" stoker and damper controls for coal, fuel oil or gas-fired boilers are actuated by water pressure and will control damper adjustment, or both damper and fuel feed where automatic stokers are used, within a variation of ¼ lb.



Ruggles-Klingeman Mfg. Co., 30 Balcomb St., Salem, Mass.

Feedwater Regulator with Two Thermostatic Tubes

Consists essentially of two extra-heavy brass expansion tubes connected into a body casting at one end and close return bend at the other. Lower tube is working element; upper, compensating element. Return bend carries lug to which valve linkage is attached. Expansion and contraction of working tubes induced by change in



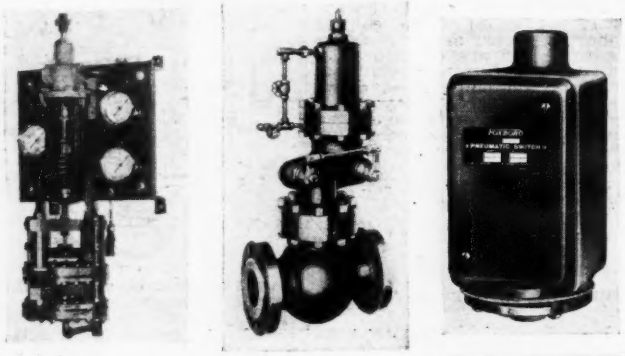
water level is multiplied and translated into vertical movement transmitted directly to valve stem.

J. A. Campbell Co., 1206 S. Maple Ave., Los Angeles, Calif.

Pneumatic Switch for Controllers

Compact and simple, this switch is claimed to make possible use of air-operated controllers on equipment controlled by electricity, such as pumps, blowers and compressors, or to produce audible or visible signals on time cycle applications. Switch is standard single-pole mercury switch mounted in cast-iron housing with outlet tapped for either conduit or BX connector. Many be used where current is not higher than 600 amp. at 220 volts.

Foxboro Co., Foxboro, Mass.



Differential-Pressure Master Control

Type CPDM differential pressure master control is used to maintain a differential between pressures applied to its upper and lower diaphragms. An auxiliary motive force, which may be air, water steam or oil, is then used to operate a single valve, a group of valve, motor rheostats, cut-out switches or other control equipment.

The Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio.

Combined Temperature and Pressure Regulator

Type ETD Spence combined temperature and pressure regulator operates on steam pressures above 1 lb. Shuts tight when desired temperature is reached. Being pilot-operated it will open wide or close tight on less than 2 deg. F., change in temperature. Does not require separate reducing valve. Thermostat cannot be injured by overheating. Over 100 deg. F. range in temperature adjustment. Pilot-operated, single-seat end regulators with interchangeable pilots in all sizes ½ to 12 in. inclusive.

Spence Engineering Co., Inc., 110 E. 42nd St., New York, N. Y.

Excess Pressure Governor

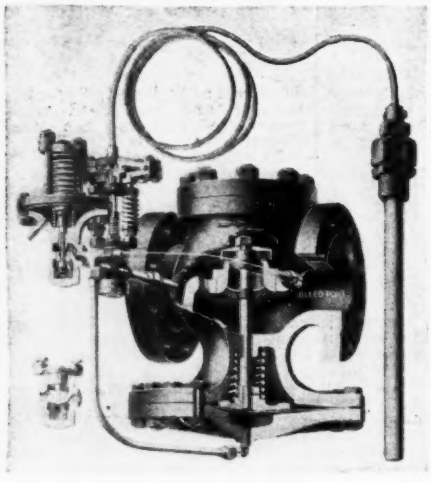
Type SDS-2 controls within close limits any excess pressure from 15 to 150 lb. Can be used on simplex, duplex or motor- or turbine-driven centrifugal pumps. 4-ply brass sylphon bellows sensitive, yet capable of withstanding 400-lb. pressure. Sylphon and spring-loading in separate chamber from valve to avoid contact with fluid. All sizes up to 6 in. with straightway or angle style bodies and for all pressure standards from 250 lb. up.

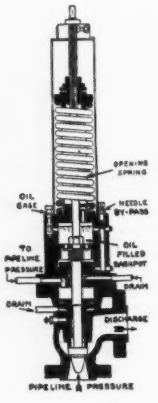
Northern Equipment Co., Erie, Pa.

Surge Suppressors

Essentially a relief valve for use with a check or automatically controlled gate valve, this surge suppressor limits water-hammer disturbances positively in a pump discharge line following shutdown. Available in several forms, including Larner-Johnson and standpipe pipe for low-head development. Valve opens with drop in pressure following shutdown, remaining open to relieve surge which follows, then closing automatically at an adjustable rate. Made by Pelton Water Wheel Co.

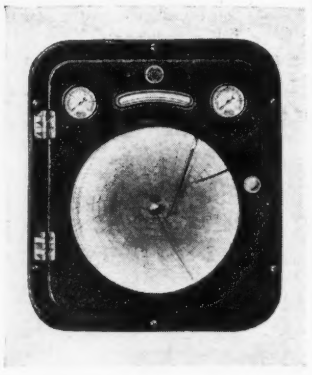
Baldwin - Southwark Corp., Southwark Division, Philadelphia, Pa.





Temperature Controller with Compensating Feature

Has "thermo-pressure compensator" which permits controller to control temperature by throttling supply of cooling

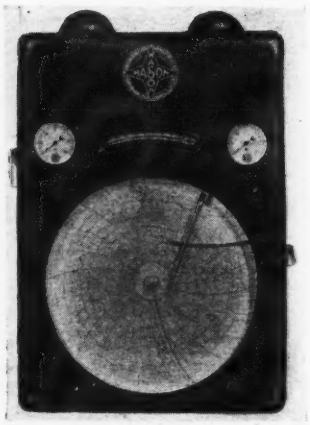


or heating medium and also compensates pressure and resultant rate of flow of medium. Compound balanced pilot valve controls diaphragm control valve, dual helical temperature coils check each other (one operates control, other inscribes record).

Mason Regulator Co., 1190 Adams St., Boston, Mass.

Pressure Control Instruments for Process Industries

Greater precision in control and simplified adjustment are claimed for this line of pressure control instruments. A Rota-Port synchronizer enables instrument to be synchronized instantly with speed of any proc-

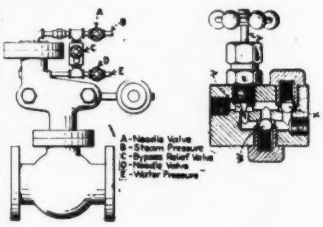


ess. Thus, for every increment of movement of control element there is definite and uniform increment of movement of diaphragm valve.

Mason Regulator Co., 1190 Adams St., Boston, Mass.

Bypass Relief Regulator for Pressure-Control Valve

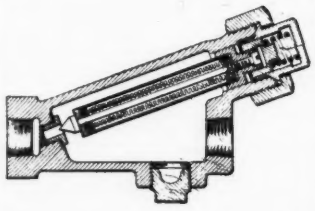
To safeguard actuating element of pressure control valve against exclusive unbalanced pressures, this two-way relief is installed between steam and water connections to valve. Springs-holding balls *W* and *X* set for maximum differential pressure of 200 lb. In normal operation, equalizing needle valve *Y* is closed, shutting off



passage *V*. Should steam pressure become more than 200 lb. greater than water pressure, ball *W* is moved from seat to permit sufficient water to flow through the opening to stabilize pressure differential. Needle valves *A* and *C* are used to throttle pressures in the steam and water connections to prevent "hunting" caused by rapid pressure fluctuations.

Northern Equipment Co., Erie, Pa.

Steam Traps



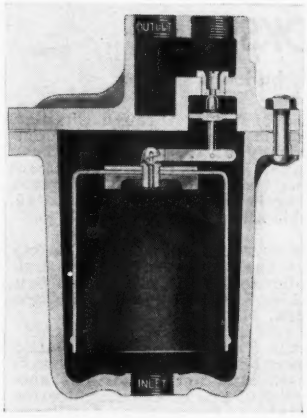
Steam Trap With Outside Pressure Adjustment

Sarco No. 8 trap is provided with outside pressure adjustment with locking device, and has a straight-way as well as angle connection. Relief spring for expansion element is built in to prolong trap life where pressures fluctuate.

Sarco Co. Inc., 183 Madison Ave., New York, N. Y.

Improved Inverted Bucket Steam Trap

These traps have improved anti-balancing device consisting of valve arrangement and lever which replaces conventional air vent and bucket. Valve is arranged with small opening to allow air and other gases to escape from bucket while trap is filling. Semi-steel inverted

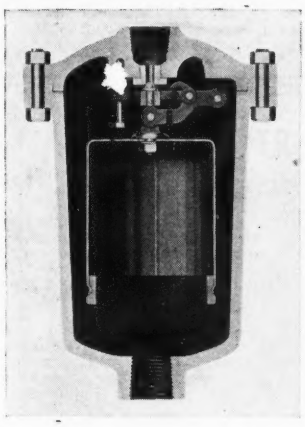


bucket trap shown. Forged steel trap also available. Both have internal Monel metal strainers, stainless buckets, Anum-metal seats, disk and operating mechanism. Pressures up to 1,800 lb.

Strong, Carlisle & Hammond Co., Cleveland, Ohio.

Inverted Bucket Trap

Type A trap has stainless steel seat and disk, large capacity, small wear, and is full-opening, non-airbinding and non-fouling. Inlet and outlet

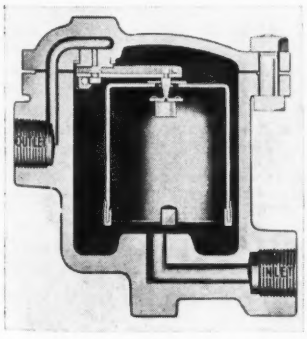


are in line for ease of installation. Hexagonal section at bottom. Bucket one-piece spun copper; levers phosphor-bronze. Accommodates pipe sizes from ¼ to 2 in.

Swartwout Co., 18511 *Euclid Ave., Cleveland, Ohio.*

Inverted Bucket Steam Traps

No. 70 (shown) and 71 Strong inverted-bucket steam traps use valve arrangement to replace conventional air vent hole in bucket. Small vent open when valve is filling. As bucket

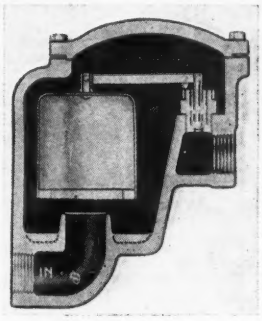


loses weight, valve is opened wide to permit sudden escape of steam and air and avoid balancing. Steam and air replaced with water which sinks bucket and opens trap discharge valve. No. 70 for pressures of 0-125 lb. and No. 71 for 0-200 lb; both semi-steel bodied. No. 71 also available with cast steel body.

Strong, Carlisle & Hammond Co., Cleveland, Ohio.

Inverted-Bucket Steam Trap

Apex Class S T inverted-bucket steam trap has simple design, rugged construction, non-air binding and side pipping connections independent of



cover. May be used for maximum pressure of 125 lb. and temperature of 450 deg., and for pipe sizes from ⅜ to 1 in. Trap bodies semi-steel, bucket bronze, valves stainless steel.

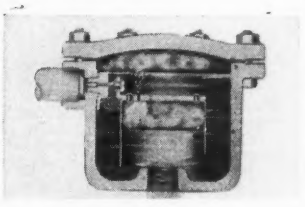
Apex Regulator Co., Division of Fisher Governor Co., Marshalltown, Iowa.

Steam Trap

Number 11 "Silvertop" steam trap is light and small. Furnished chrome-plated and polished as extra. Working parts stainless steel. One-bolt as-

sembly. Valve and seat Nitralloy, heat-treated. Can be used either as an elbow or straight-in-line. Non-air-binding and automatic. Regular, ½-in. pipe connections; ¾-in. connections if desired.

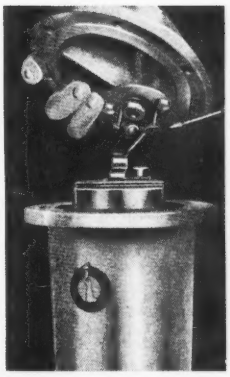
V. D. Anderson Co., Cleveland, Ohio.

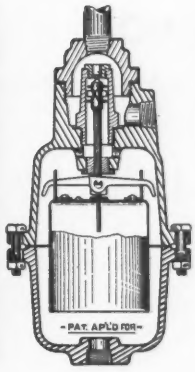


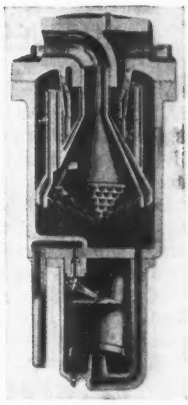
Inverted Open-Float Steam Traps

These small, efficient steam traps for draining condensation from small steam-heated units are claimed simple in operation. Available in sizes of ½, ¾ and 1 in. for pressures to 150 lb.

Crane Co., 836 *S. Michigan Ave., Chicago, Ill.*







Spade-Thayer steam trap at center; "Direct Separator" combination air separator and trap at right.

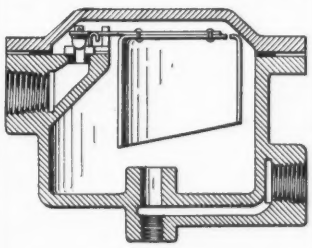
Improved High-Capacity Steam Trap

These free-floating lever steam traps use inverted-bucket principle characteristic of Armstrong traps. Cast semi-steel for pressures to 250 lb. In forged steel for 600, 900 and 1,500-lb. pressure service with any degree of superheat. Also compound traps for handling large volumes of water at any pressure and special traps for pulsating pressure conditions.

Armstrong Machine Works, Three Rivers, Mich.

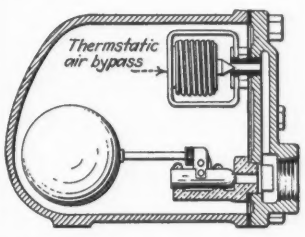
Inverted-Bucket Steam Trap

"K-Master" Midget modernized inverted-bucket steam traps have but one moving part. Side inlets and outlets avoid



cooling leg. Water passage is simple, and large-size valve provides increased capacity. No mechanism is attached to cover. Compound rocking fulcrums on a single lever avoid fixed pivots. Inlet and outlet are ¾ in.

Kaye & MacDonald, Inc., 94 *Franklin Ave., West Orange, N. J.*



Float Trap

Sarco FT-O float trap with thermostatic air bypass is adapted for risers, small mains and unit heaters. It has integral thermostatic air vent inside trap, all working parts mounted on cover. Spherical valve head for maximum capacity. Inlet and outlet ¾ in., but can be furnished in 1-in. sizes. Discharge capacities at low pressures, for a differential of ½ lb., is 750 lb. per hour, for a differential of 10 lb., 4,500; for high pressures, and differential of 10 lb., 1,100 lb. per hour, and differential of 60 lb., 2,800 lb.

Sarco Co., Inc., 183 *Madison Ave., New York City.*

Steam Trap

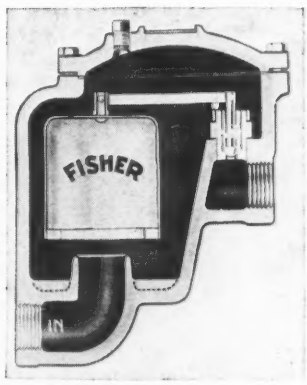
This inverted-bucket type steam trap for both high and low pressures has inlet at bottom, outlet at top, with optional outlet at right. When side outlet is used, valve and seat can be replaced without disturbing piping. Features include: high valve-opening leverage, wide opening between valve and seat, rotating valve action for self-seating, all parts non-corrosive.

Spade-Thayer Co., 307 *Bird Ave., Vandercook Lake, Jackson, Mich.*

Combination Air Separator and Trap

This combination air separator and trap incorporates company's standard separator unit. Velocity of entering air downward throws entrained moisture to top surface of cone, from whence it drains over edge to water chamber. Flow of air turned upward to and into top of three tubes leading to inner surface of cone, where flow is again changed upward to pass into outlet. Water and oil removed from air passes downward through passage in trap body into inverted bucket at center bottom. Sizes from ½ to 2 in.

Direct Separator Co., Inc., Syracuse, N. Y.



Inverted Bucket Steam Trap

Class St trap has adjustable valve post, positively guided inner valve, spur brass inverted bucket trap, body and cover of semi-steel, lever and pins stainless steel, as are valve and orifice seat. Pipe connections horizontal with vertical offset.

Fisher Governor Co., Marshalltown, Iowa.

BUSINESS NOTES

MARLIN-ROCKWELL CORP., Jamestown, N. Y., has consolidated sales activities of its three subsidiaries, Gurney Ball Bearing Division (Jamestown, N. Y.), Standard Steel & Bearings, Inc. (Plainville, Conn.), and Strom Bearings Co. (Chicago, Ill.). Bearings manufactured by the above companies will be available through the corporation's sales organization with offices as follows: Marlin-Rockwell Corp., 402 Chandler St., Jamestown, N. Y.; Eastern District Sales Office, Woodford Ave., Plainville, Conn.; Western District Sales Office, 2526 S. Michigan Ave., Chicago, Ill.

ELLIOTT CO., Pittsburgh, Pa., and associates, The Lagonda Mfg. Co. and Liberty Mfg. Co., have moved their Baltimore district office to Washington, D. C., at 918 Washington Loan & Trust Bldg., 9th & F Sts., N.W. H. C. Hale is district manager. C. H. Russell remains in Baltimore at 3602 Calloway Ave., as resident sales engineer.

HENRY VOGT MACHINE CO., Louisville, Ky., has appointed J. R. Fortune & Son, 608 Fisher Bldg., Detroit, as district representative for Vogt equipment.

MARK G. MUELLER, 1700 16th St., Denver, Colo., has been appointed district sales agent for Colorado, New Mexico and the western part of Kansas, of Roller-Smith Co., 233 Broadway, New York, N. Y. The company has also appointed Burkholder & Kelley, 105 Cortleigh Blvd., Toronto, Ont., Canada, as district sales agent for Canada.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION has moved its offices from 1415 Enquirer Bldg., Cincinnati, Ohio, to 1220 Guarantee Title Bldg., Cleveland.

ROOTS-CONNERSVILLE-WILBRAHAM, Connersville, Ind., has moved its New York office to 24 State St. D. L. Dowling, district manager, heads the staff.

BURNS & MCDONNELL ENGINEERING CO. has opened an office at 612 Dixie Terminal Bldg., Cincinnati, Ohio, in general charge of C. F. Lambert, member of the firm, with H. J. Rosson as office manager.

KAYE & MACDONALD, INC., 94 Franklin Ave., West Orange, N. J., has appointed Boig & Hill, Inc., 87 Barclay St., New York, N. Y., as state representative.

WEEKS MERIT SYSTEM, INC., 228 Aborn St., Providence, R. I., has appointed Parry Engineering Co., Chrysler Bldg., New York, N. Y., as New York representative for the Merit system of combustion control for oil-fired boilers.

ERIE CITY IRON WORKS has appointed J. R. Stewart as district sales agent in Detroit, with offices at 17511 Pennington Drive.

DAVIS ENGINEERING CORP., 90 West St., New York, N. Y., has appointed Frederick E. Bausch, 1614 Chemical Bldg., St. Louis, Mo., as representative in that district for the company's line of hot water heaters and other specialties.

FRED C. ARCHER has been appointed manager of the Philadelphia district of Lincoln Electric Co., Cleveland, Ohio. Mr. Archer was formerly president of Fred C. Archer Co., which he organized in 1925.

THE ENGINEER'S BOOKSHELF

Reports, surveys, experiment station bulletins

N.D.H.A.—Report of Research Committee of the National District Heating Association for 1931-1932 has been issued in booklet form.

SYMPOSIUM ON RUBBER—American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., has gathered the 12 papers of its recent symposium on rubber together in a single volume.

CAST IRON—"The Effect of Size of Specimen on the Strength and Elastic Properties of Cast Iron," by A. H. Dierker, is Bulletin No. 72 of the Engineering Experiment Station, Ohio State University, Columbus, Ohio. It is available for $0.25.

CLINKER FORMATION—The Bureau of Mines of the U. S. Department of Commerce has issued Bulletin 364 on "Clinker Formation as Related to the Fusibility of Coal Ash" which is available from the Superintendent of Documents, Washington, D. C., for $0.10.

ELECTRIC LIGHT & POWER INDUSTRY—Statistical Bulletin No. 8 of N.E.L.A., "The Electric Light & Power Industry—1931" now available from National Electric Light Association, 420 Lexington Ave., New York, N. Y. Publication No. 292—$0.50 to members and $0.75 to non-members.

OIL SPRAYS—Pennsylvania State College Bulletin No. 40, "On the Formation and Dispersion of Oil Sprays," by Kalman J. DeJuhasz, O. F. Zahn, Jr., and P. H. Schweitzer is the report of an experimental investigation of the behavior of fuel sprays under conditions encountered in fuel-injection engines, particularly on spray formation and dispersion. It is available for $1.00 from the Station.

WEIRS—Flow of Water through Circular, Parabolic, and Triangular Vertical Notch-Weirs, a paper by F. W. Greve, has been printed by the Engineering Experiment Station, Purdue University, West Lafayette, Ind., as Research Series Bulletin No. 40, and is available there.

SAFETY CONFERENCES—Foremen's Safety Conferences is the subject of a new bulletin by Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y.

SCREW THREAD STRESSES—"Determination of Stress Concentration in Screw Threads by the Photo-Elastic Method" is the subject of Bulletin No. 245 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. Available from the station for $0.10.

NAVAL ARCHITECTS—The Society of Naval Architects and Marine Engineers has published a 1932 edition of its Year Book, including a complete index of the *Transactions* of the Society from 1893-1930. It gives general information of the administration and list of members and similar information.

CITY OF SEATTLE—The Annual Report of the Department of Lighting, City of Seattle, Wash., for the year ending Dec. 31, 1931, has been printed in booklet form.

TRADE ASSOCIATIONS—A classification and statistical survey of the activities and services of 500 associations is included in the booklet, "Trade Association Activities," issued by the Trade Association Dept., Chamber of Commerce of the United States, Washington, D. C.

IN THE POWER MART

Manufacturers' new bulletins describe developments

WELDING EQUIPMENT—Lincoln Electric Co., Cleveland, Ohio, has issued a new bulletin, "The New Lincoln 'Shield-Arc' Welder," drescribing this piece of equipment.

PRESSURE RELIEF AND BACK-PRESSURE VALVES—This is the subject of a new circular on units of this type on a positive spring compensator manufactured by Schutte & Koerting Co., Valve Dept., 12th and Thompson Sts., Philadelphia, Pa.

CONSTANT-TENSION DRIVE—Reliance Electric & Engineering Co., Cleveland, Ohio, has published Bulletin 602 describing the Reliance constant-tension drive for application to any process requiring a constant tension in material being wound onto or unwound from a reel.

FREYN DESIGN—"Freyn Design" is the title of a new publication by Freyn Engineering Co., 310 S. Michigan Ave., Chicago, Ill. The current issue describes production at Kuznetsk, Russia; progress of South African blast furnace; improvements in pressure burners; performance of Theisen disintegrators, and journeys to the iron mines of Russia.

MECHANICAL FLOW METERS—Brown Instrument Co., Philadelphia, Pa., has published a broadside featuring the announcement of the new Brown mechanical flow meter recently described in *Power*, and offering a catalog on the meter to those interested.

CONDENSATION METER—Central Station Steam Co., Detroit, Mich., has issued Catalog No. 14 describing the "Cadillac" condensation meter and giving a technical description, list of applications and a table of sizes and dimensions.

INERTAIRE EQUIPMENT—Leaflet 20550, published by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes new "Inertaire" equipment requiring no chemicals or gas generator to maintain the layer of inert gas over the oil in a transformer.

SINGLE-STAGE TURBO-BLOWERS—Bulletin 1908 on this subject of Allis-Chalmers Mfg. Co., Milwaukee, Wis., describes one of the new lines of products acquired through purchase of the principal assets of American Brown Boveri Co.

METERING SYSTEM—A new metering system combining the new OC detachable watthour meter, new portable stroboscopic standard, and the nofuze load center is described in Circular 1960 published by Westinghouse Electric & Mfg. Co., Newark, N. J.

HEAVY-DUTY TIME STARTERS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet 20554, on Class 8518 heavy-duty time-starters for constant-speed d.c. motors.

GAS TORCHES—Linde Air Products Co., 30 E. 42nd St., New York, N. Y., has issued "Prest-O-Lite Torches," a booklet describing soldering, brazing and heating equipment manufactured by the company.

SQUIRREL-CAGE INDUCTION MOTORS—Linestart Type CS squirrel-cage induction motors are described in a new bulletin by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Motors are equipped with sealed sleeve bearings, are available for all commercial frequencies and voltages, and are built in sizes from 3 to 200 hp.

FUSELESS PROTECTION—This is the subject of Westinghouse publication C-1956, describing the "Nofuze" load center and its application to supplying fuseless home circuit attention.

SQUIRREL-CAGE MOTORS—General Electric Co., Schenectady, N. Y., 4-page pamphlet No. GEA-16Z8 on squirrel-cage motors and control.

HOIST MOTORS—G. E. small a.-c. hoist motors, Type KR, totally inclosed, are described in GEA-1366 of General Electric Co., Schenectady, N. Y.

CARBON BRUSHES—Brushes for single-phase and other fractional-horsepower motors are described in Catalog No. 13 of Boxill-Bruel Carbon Co., Columbia Park, Ohio. Included are carbon plates, round carbons, utility brush strips, commutator stones, small brush kits, cable, terminals, alloy and tamping tools.

METAL DEGREASING—"Improved Methods of Industrial Metal Degreasing" is the subject of Special Development Bulletin No. 18 of Dow Chemical Co., Midland, Mich. The booklet is arranged so that it may be filed in a folder file.

How a Physician and a Druggist evolved a tonic for American Industry

MORE than fifty years ago Keasbey, a druggist, and Mattison, a doctor, found a new use for magnesia. They formed a partnership and soon after applied their common knowledge to heat insulation. Later they experimented with asbestos. From these two materials they evolved a complete line of insulation products which have contributed enormously to the present high development of industrial power.

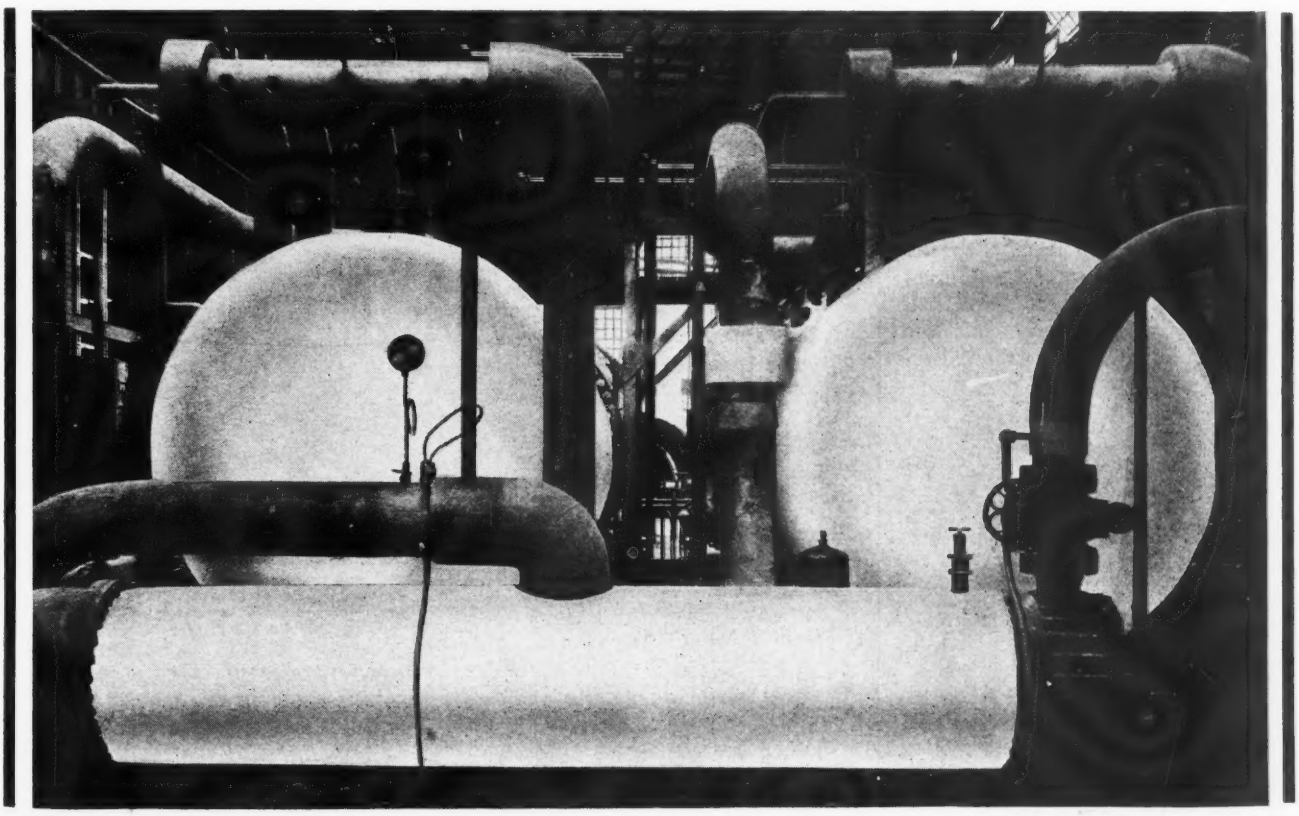
From the beginning, Keasbey and Mattison realized that insulation was primarily an engineering problem. To supply efficient coverings, at fair prices, for even the most complex of installations then became the object of K & M efforts. Success in this depended upon two things: the effective cooperation of K & M technicians with company engineers, and the excellence of the materials used.

Simply because Keasbey and Mattison products have proved outstanding in performance year in and year out, many engineers now specify them on all jobs, large and small—from pipes to boiler. The present extensive use of K & M Featherweight 85% Magnesia where lightness and economy are both prime requisites, is a good example of this.

K & M Featherweight 85% Magnesia is lighter because it contains more "dead air" cells. This results from our manufacturing process wherein pure magnesia crystals, irregular in shape, are interlaced and netted so that the percentage of voids may be as high as 95%. Extraordinary strength comes from the carefully selected asbestos fibres from our own mines.

Today our engineers are ready to assist all clients. They have found the right answer to many difficult insulation problems in the past and can be of practical value to you now. Consult us at any time.

Keasbey and Mattison Insulating Materials are an unfailing barrier against heat-loss.



Keasbey & Mattison Company
AMBLER . . . PENNSYLVANIA

K&M

VALVE NEWS

JENKINS BROS., 80 White St., New York, N.Y.; 510 Main St., Bridgeport, Conn.; 524 Atlantic Avenue, Boston, Mass.; 133 No. Seventh St., Philadelphia, Pa.; 646 Washington Blvd., Chicago, Ill.; JENKINS BROS., Limited, Montreal, Canada; London, Eng. Factories: Bridgeport, Conn.; Elizabeth, N. J.; Montreal, Canada.

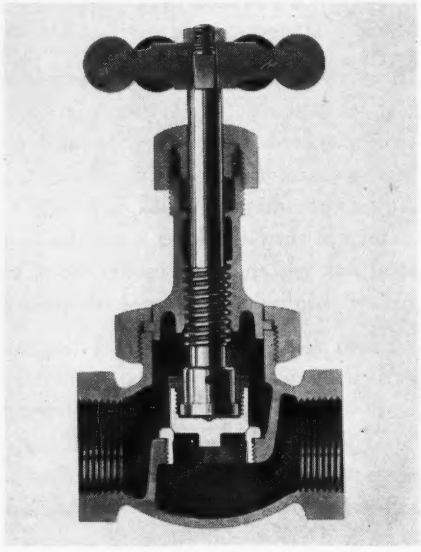
Management Scrutinizes the Power Dollar

All signs indicate that in the years ahead, as never before, management will closely scrutinize the costs of running the power plant. Every dollar of expenditure for fuel and other items is going to be made to justify itself. Power must come down in keeping with other expenditures. Much progress already has been made. More will be demanded. This sentiment was evident on all sides at the recent POWER SHOW in New York.

Authorities tell us that of all plants built within the last five years 90% can demonstrate an overall saving of at least 10% by the introduction of better equipment and accessories.

Since valves enter so widely in the generation, distribution and consumption of power, they contribute important opportunities for achieving worth while economies. A keen realization of this fact is responsible for the genuine quality that is built into every Jenkins Valve, a quality that alone makes possible the splendid performance for which Jenkins are known.

Jenkins Bros

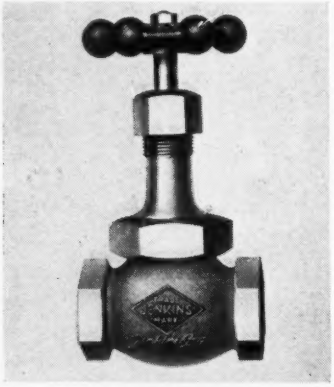


Sectional View, Fig. 950, Jenkins Bronze Regrinding Union Bonnet Globe Valve, Screwed.

Jenkins New 200 lb. Bronze Globe Valve Arouses Wide Interest At Recent Power Show

Renewable Nickel Alloy Seat Ring and Disc Prove Popular Features of Latest Regrinding Valve

Enthusiastic endorsement of Fig. 950 Jenkins Bronze Regrinding Globe Valve was to be heard everywhere at the recent Power Show held from December 5 to 10 in the Grand Central Palace, New York. One of the most popular valves on exhibit in the Jenkins Booth, Fig. 950 won the approval of the many hundreds of engineers who saw it.



New! Fig. 950, Jenkins Bronze Regrinding Union Bonnet Globe Valve, Screwed, with renewable nickel alloy seat ring and disc. For 200 lbs. steam or 300 lbs. oil, water, gas working pressure.

Made in globe and angle patterns, screwed and flanged, in sizes ¼ to 3 inches, this new Jenkins Bronze Regrinding Valve sets a new standard in valve design and construction. Guaranteed for 200 lbs. steam as well as 300 lbs. oil, water, gas working pressure, it meets the stringent requirements of the United States Steamboat Inspection Bureau.

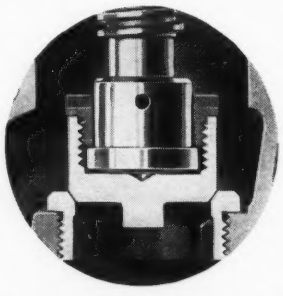
Among the many features of these new bronze globe and angle valves are the following:

WHEEL: This is a durable iron wheel of the ball type, enamelled green. It affords a good grip when regrinding the valve.

PACKING NUT: A strong hexagon nut screws over the stuffing box in top of bonnet. It holds the follower and packing in position.

FOLLOWER: Bronze gland or follower holds packing around spindle preventing leakage.

STUFFING BOX: Extra deep, generously packed with asbestos ring packing of exceptional durability.



View showing the unique seating arrangement. The beveled contacting surfaces of disc and seat ring make possible a wedge-like action in closing that permits tight seating. See text for important advantage of this construction. Note hole in spindle for regrinding pin.

IMPORTANT: When the valve is opened wide, a beveled shoulder on the spindle is arranged to engage snugly with the beveled surface at the bottom of the bonnet, so that the stuffing box can be repacked while the valve is in service under full pressure.

(Continued on Next Page)

JENKINS VALVES ARE ALWAYS MARKED WITH THE "DIAMOND"

(Continued From Preceding Page)

SPINDLE: Of manganese bronze. Note the number of spindle threads in contact with the bonnet. This provides longer wear and more service.

UNION BONNET: Sturdy screw-over union ring design provides speedy removal and quick access to seat. Use of a flat seated joint with guide makes possible perfect contact between bonnet and body. It assures correct alignment of parts during the regrinding operation.

Bolted bonnets can be furnished with 2½ and 3 inch valves, to conform to the U. S. Steamboat Inspection requirements.

BODY: Of attractive design, with full passages offering the least friction to fluid flow.

The words REGRIND-RENEW are cast on the outside of the body.

DISC: *Nickel alloy,* removable and regrindable. The disc is very substantial. It has a radial face where it contacts the seat ring and so assures perfect seating.

IMPORTANT: *The diameter of the disc is smaller than the diameter of the seat ring measured at the top of the bevel seat. This being so, neither wear, corrosion, erosion, throttling effects, nor regrinding can cut or set up any shoulders, grooves, ledges or the like in the disc which may cause the valve to leak.*

Jenkins exacting attention to the correct construction of this detail makes Jenkins the regrinding valve that stays tight.

SEAT RING: *Nickel alloy,* removable and renewable. Assures tight, leak-proof seat.

These Valves Serve Industry in Many Important Applications

Jenkins Quality Obtainable in Wide Range of Designs

In addition to a complete line of globe, angle, cross, check and gate valves, in standard, medium and extra heavy patterns in bronze, iron and steel, Jenkins Bros. have designed a number of bronze and iron body valves that have found wide application in a diversity of industrial work.

The accompanying illustration shows only a few of these many valves, as follows:

Fig. 750, Bronze Union Bonnet Regrinding Globe Valve. For 200 lbs. steam pressure.

Fig. 743, Standard Bronze Needle Globe Valve, with bronze spindle. For close regulation of air, gasoline and other thin liquids.

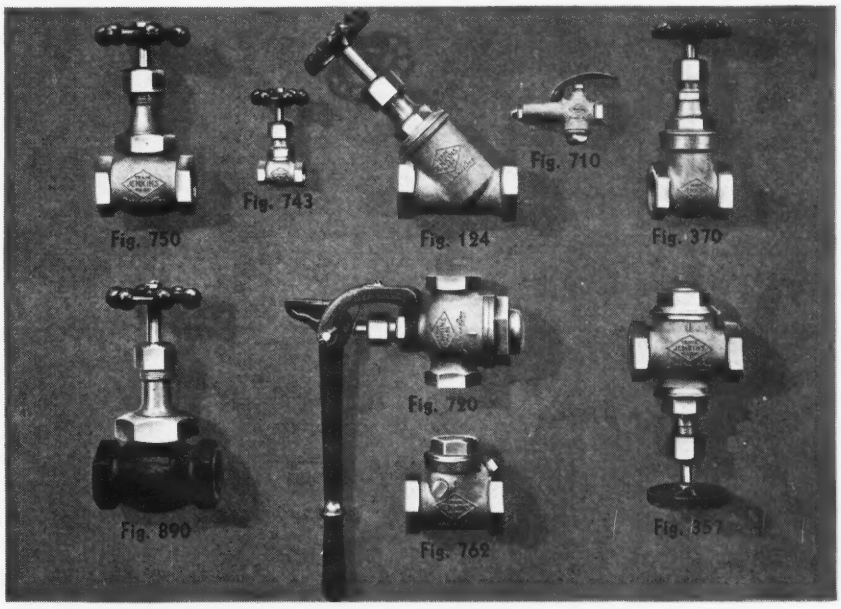


Fig. 124, Standard Bronze Y or Blow-Off Valve. Opening is practically in line with pipe. Renewable disc and seat ring.

Fig. 710, Air Gun. Renewable disc specially compounded for compressed air service. Standard, flat, rounded or extension tip.

Fig. 370, Standard Bronze Solid Wedge Gate Valve with inside screw.

Fig. 890, Iron Body Bronze Mounted Regrinding Globe Valve with renewable nickel alloy seat ring and disc.

Fig. 720, Bronze Rapid Action Valve. For hot and cold water and other fluids. Quick flow, on and off.

Fig. 762, Bronze Regrinding Swing Check Valve. Renewable bronze disc.

Fig. 357, Bronze Selclo Valve. For severe service where valve is operated hurriedly or carelessly.

In writing for information, mention the specific conditions under which the valves you have in mind must service.

Engineers Choose Jenkins Gates For Hard Plant Duties

Jenkins Iron Body Gate Valves possess the brawn and stamina that appeal to practical engineers.

Of the popular globe-like body design with oval neck, providing maximum strength for high pressure service, these Jenkins Gates bring to every heavy duty valve job protection and safety against the strains and stresses of pressure, pipe weight, settling and frequent operation. They assure long reliable valve performance. Made with solid wedge or double disc parallel seats, there is a Jenkins Gate Valve for every iron body gate valve requirement.

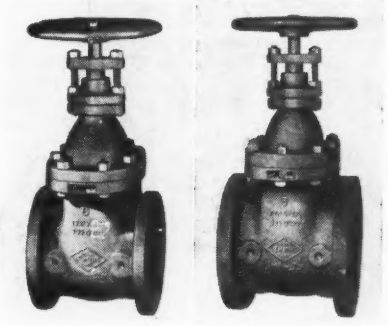
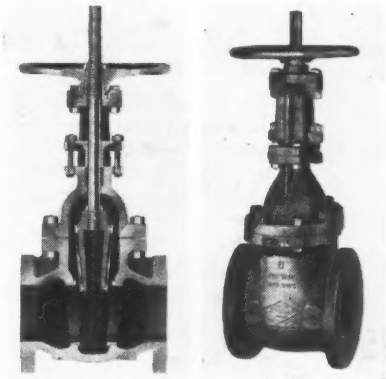


Fig. 326. Standard Iron Body Gate Valve, Flanged. Inside screw.

Fig. 255. Medium Pressure Iron Body Gate Valve, Flanged. Inside screw.



Sectional view, Fig. 204. Extra Heavy Iron Body Gate Valve, Flanged. Outside screw and yoke.

Fig. 651. Standard Iron Body Gate Valve, Flanged. Outside screw and yoke.

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BRONZE IRON STEEL
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Since 1864

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Portable "Air-King"—gasoline engine and electric motor drive; 110 cu. ft. to 360 cu. ft. displacement; single-stage and two-stage; horizontal and vertical; motor truck, tractor, trailer, railroad car and mine car mountings. For contractor, railroad, mine, quarry and industrial requirements.

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Rock Hammers for hand drilling rock, shaft sinking, etc. Auger drills for coal mining. Drifters for mine tunneling, opening and development work, and hydro-electric construction work, aqueducts, dams, locks, etc. Broaching drills. Plug and feather drills. Forging furnaces and automatic heat treating machines for drill steel. Drill steel, hose and other accessories.

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Vertical types for direct power or generator service—stationary and marine service.

Single-acting—two-cycle, direct injection; four-cycle, air or direct injection.

Double-acting—two-cycle, air injection.

Ranges of power through various types from 50 hp. to 12,000 hp.

GAS ENGINES

Horizontal four-cycle double-acting type; utilizing natural or blast furnace gas; for power or gas compressor service. Sizes 160 hp. to 5000 hp.

Vertical four-cycle single-acting type; for generator and general power service. Sizes 50 hp. to 1800 hp.

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V-molded rubberized cord belts running in V-grooved sheaves. Wedging contact transmits power smoothly, efficiently and economically over short centers. Capacities ½ hp. to 1000 hp. Developed in conjunction with Goodyear Tire and Rubber Company.

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Steam Pumps—Reciprocating crank-and-flywheel and direct-acting types; simplex, duplex and duoplex; horizontal and vertical; piston and plunger; simple, compound and triple expansion; condensing and non-condensing. Complete lines of pumps for water, hot and cold oil, and other liquids.

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Power Pumps—Horizontal and vertical; single, duplex and triplex; piston and plunger; for belt, gear, motor or engine drive. A wide range of sizes and types for all kinds of service.

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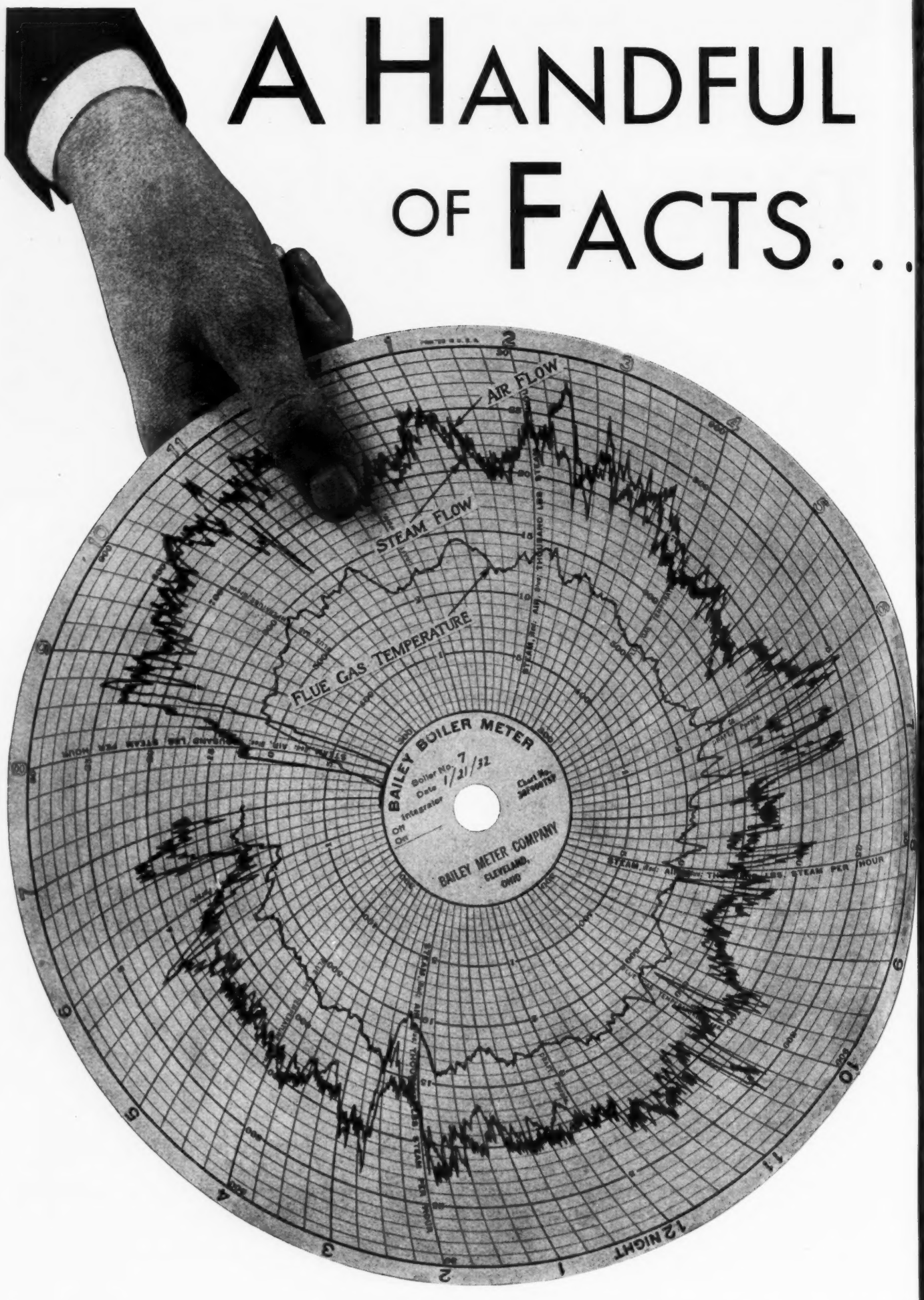

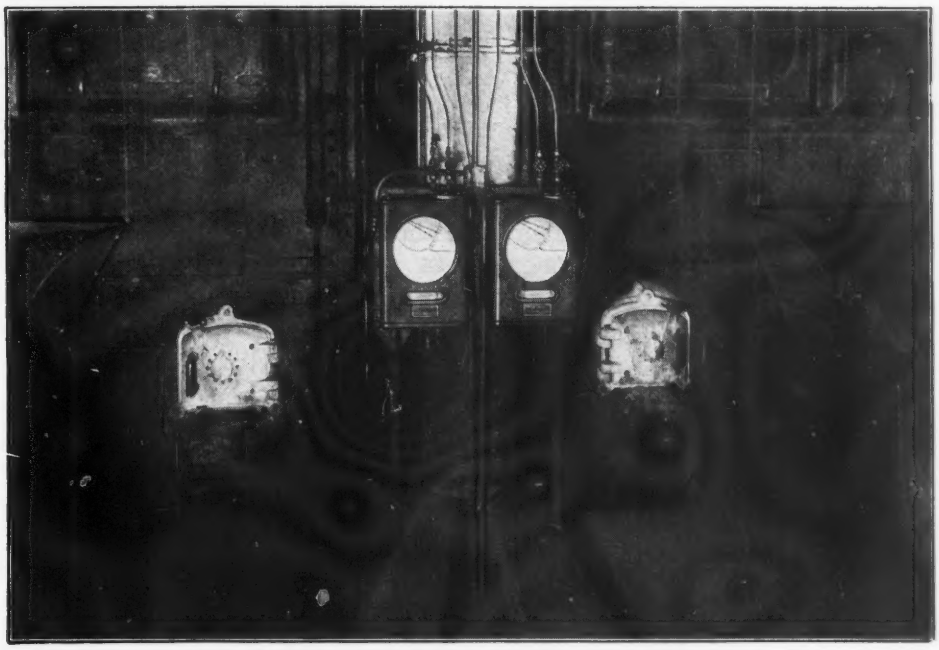

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Merely a chart from a Bailey Boiler Meter . . . but daily charts like this have led another industrial plant to increased profits. By guiding operation of seven 400 h.p. stoker fired boilers with Bailey Boiler Meters, a large eastern soap manufacturer is saving approximately $100.00 weekly in fuel costs alone. The initial investment was returned in a few months and the equipment continues to pay ample dividends week after week.

Each Bailey Boiler Meter presents to the operator in a logical manner the handful of facts essential to economical boiler operation. It totalizes and records Steam Flow from the boiler, records Air Flow supplied for combustion, and records Flue Gas Temperature. Observation of this data enables the operator to continuously maintain the correct air supply and to clean tubes or repair baffles at the proper time. Let us show you how Bailey Boiler Meters can increase your margin of profit. Write for Bulletin No. 44.

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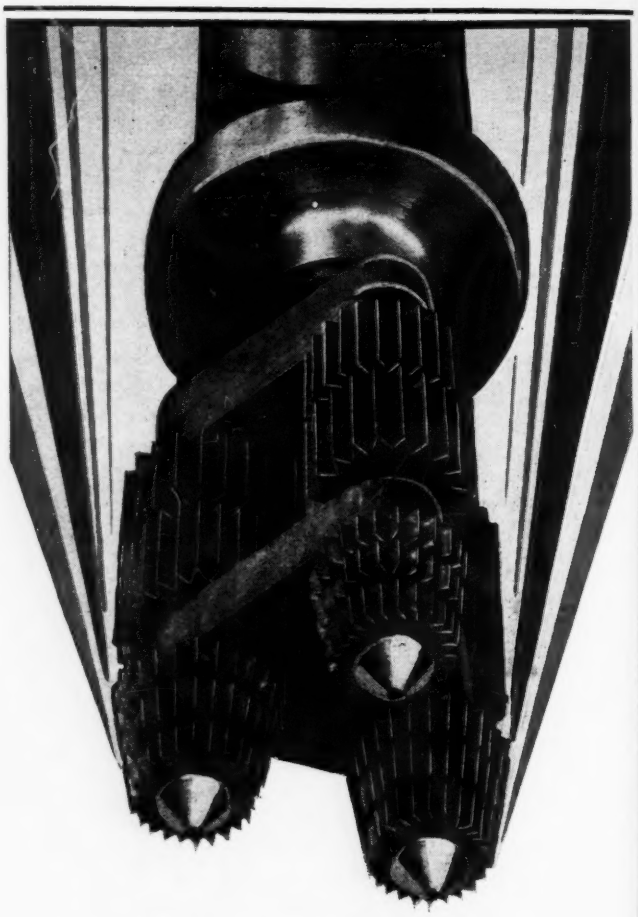

THEY PUT SPEED INTO IT

They drive through a scale-encrusted tube in racing time, chase out the deposit, and get the unit back on the line—and on the right side of the ledger—with least possible delay. They save the minutes that count up into money.

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Moving individually in both directions by their own power cylinders—giving economy over wide load range and fast, positive, trouble-free governing.

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Reducing pressure loss between turbine and condenser—increasing efficiency.

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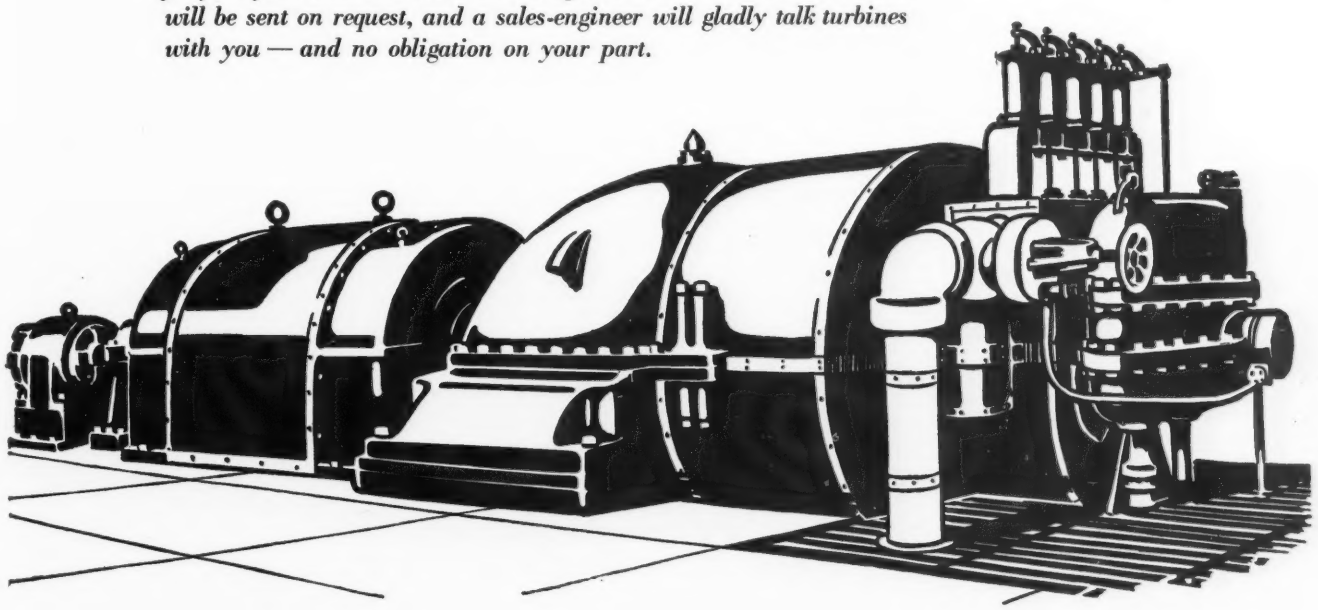
Elliott engineers have not slighted a single detail in design, workmanship or material to make this the best turbine-generator unit for industrial plants, municipal plants and smaller central stations.

Let's check these and many more potent reasons why you should be fully informed on Elliott turbine-generator units. Bulletin H-7 will be sent on request, and a sales-engineer will gladly talk turbines with you — and no obligation on your part.



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OPERATION

Plungers A are turned down in cylinders B against cylindrical charges of special Yarway semi-plastic packing C, forcing packing to flow through drilled channels E into stuffing-box G. Deflector vanes F serve to direct entering packing in the same clockwise movement around the gland. Hence, new packing is distributed evenly in the packing space, merging with and supplementing the packing already in the stuffing box to keep joint tight.

To insert a new supply of packing in each cylinder, simply unscrew cylinders from gland, insert new charge and replace cylinder in gland. This may be done while steam lines are under full pressure, without danger or difficulty.

Yarway Gun-Pakt Expansion Joints are covered by basic and detail patents, granted and pending, owned and controlled exclusively by the Yarnall-Waring Company.

YARWAY

The First Major Expansion

a Revolutionary Expansion Joint Development by YARWAY

GUN-PAKT makes repacking of Yarway Expansion Joints *under full steam pressure* as easy as pressure-gun lubrication.

GUN-PAKT does with a twist of a wrench what otherwise would require a shutdown, hours of labor among hot pipe lines in a crowded tunnel, the removal of packing glands, the digging out of old, deteriorated coil packing, and the fussy fitting of the new. All usually at the most embarrassing time in zero weather when steam lines are being forced to supply normal temperature requirements.

GUN-PAKT Expansion Joints are already in actual service in representative plants. Likewise, tests in the Yarway research laboratory have already duplicated the expansions and contractions under pressure which would have taken place in this type of joint during twenty years of normal service. The years of service represented by these strenuous tests continue to mount as these tests go on and on.

GUN-PAKT system and packing, it has been proven, are good for pressures ranging from sub-atmospheric to the highest pressures and temperatures used in modern steam heating practice.

GUN-PAKT Expansion Joints embody both outside and inside cylinder guides for rigid accurate alignment.

GUN-PAKT Expansion Joints cost but little more than standard Yarway Expansion Joints with conventional glands for coil packing. (Both types of glands will continue to be available as optional equipment on the complete line of Yarway Expansion Joints).

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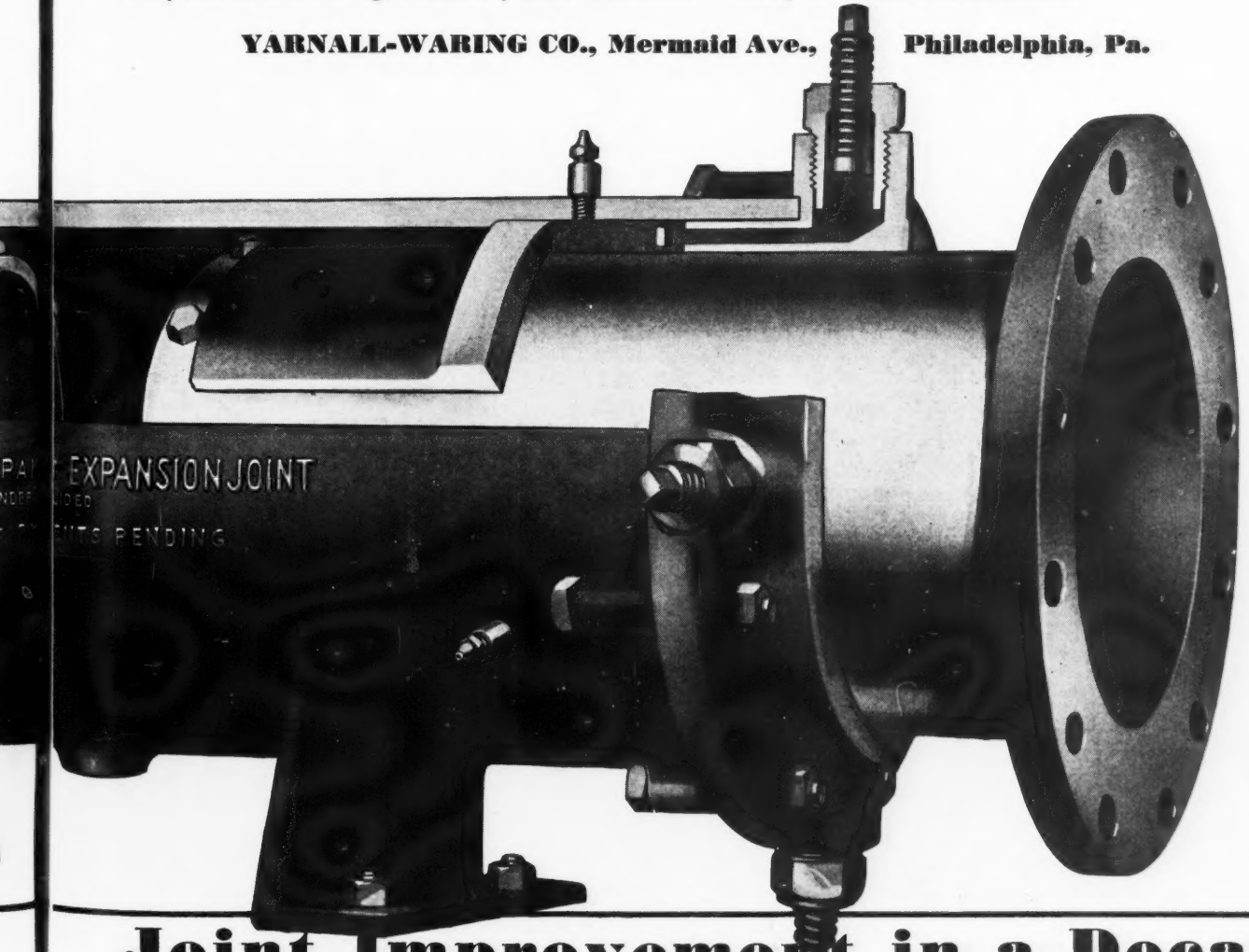

Joint Improvement in a Decade

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The Vulcan

was submerged six weeks

— then they called a G-E Service Shop

The Vulcan sprang a leak and sank with all equipment

THE dredge, *Vulcan*, docked at Peoria, Ill., sprang a leak, and sank to the bottom of the Illinois River.

Six weeks later, they called on the Chicago G-E Service Shop to recondition her electric apparatus—7 motors, totaling 772 hp.; a 75-kw. generator and exciter; 2 compensators; 4 drum controllers; 2 switchboards; and 3 75-kv-a. transformers—all G-E, by the way.

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A Chip Off the Old Block

LIKE A STURDY OAK

the Hall System of Boiler Water Conditioning has taken root in America's finest boiler plants.

Enormous boilers, terrific ratings, intense furnace temperatures, high steam pressures—and yet, in spite of the severity of these conditions, Hall System produces freedom from scale and corrosion, and protection against embrittlement.

Hall Laboratories' service could not be extended to the small plants of this country, so we formed

THE BUROMIN COMPANY

This Company—under the direction of Hall Laboratories—is doing for the small plants what the parent organization is doing for the big plants.

When you are ready to clean up your boiler scale and corrosion problems *once* and for all, write The Buromin Company, 304 Ross St., Pittsburgh, Pa. Sponsored by Hall Laboratories, Inc.

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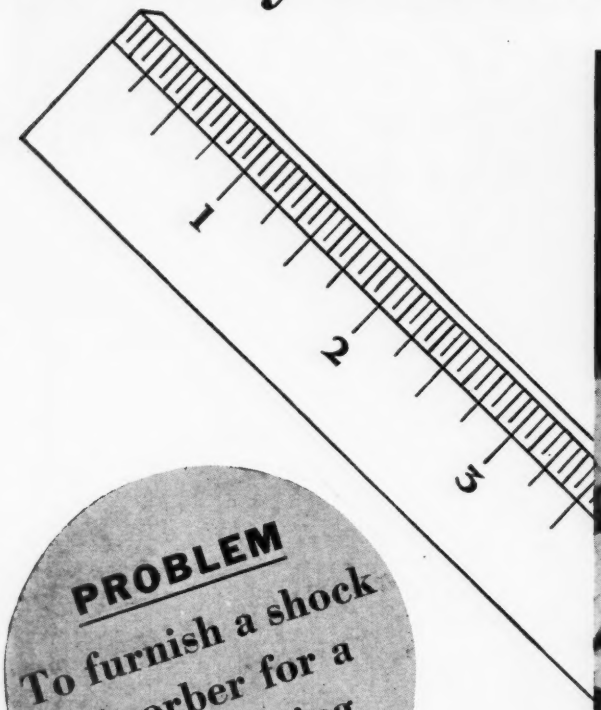
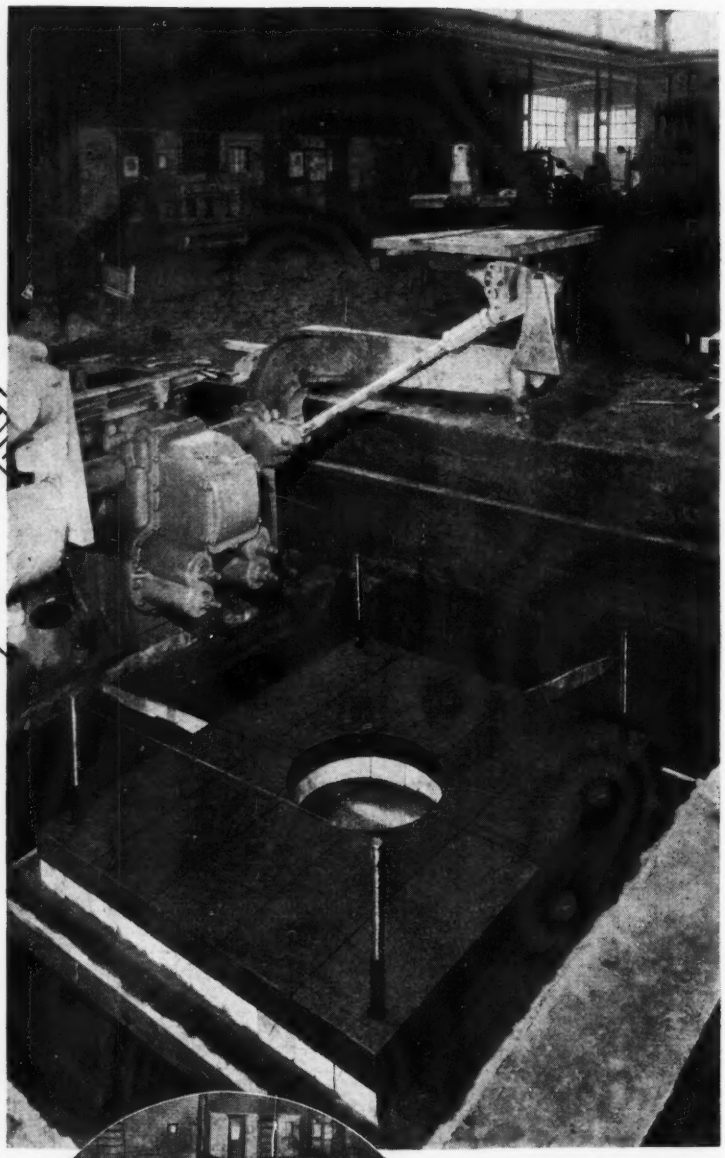
What yardstick can answer this?



PROBLEM

To furnish a shock absorber for a mold jarring machine



HOW THE NATIONAL ALLOY STEEL COMPANY *built up a foundation for a large mold jarring machine. Armstrong's Vibracork was given the job of quieting noise and limiting vibration to the machine itself.*

DID you ever build a "shock-absorbing" bed for vibrating machinery? National Alloy Steel Company did recently. They isolated a heavy mold jarring machine—and Armstrong's Vibracork supplied the "shock absorbers"!

That's one of cork's peculiar characteristics. Its resiliency enables it to absorb the shocks of high-speed machinery. Cork does not take a "set" even under sustained compression. It does not deteriorate or disintegrate. For these reasons, engineers are finding Armstrong's Vibracork a valuable cushion to absorb vibration and muffle the noise nuisance that it causes.

You'll find plenty of places in your own plant where this efficient cork cushion can justify its modest cost. Wherever vibration and noise are present you can eliminate a large proportion of both by the proper use of Armstrong's Vibracork.

There's competent advice at your service when you do decide to quiet your noisy machinery. Armstrong engineers have had practical experience in isolation problems involving machines of all types and sizes. Write for complete data and samples to Armstrong Cork & Insulation Company, 956 Concord Street, Lancaster, Pa.; Canadian offices in Montreal, Toronto, and Winnipeg.

Armstrong's (A) Product

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The Cork Cushion That Smothers Vibration

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REPRESENTATIVES EVERYWHERE

COPES
SYSTEM OF BOILER FEED CONTROL

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HERE IS PROOF OF "FIRST CHOICE"

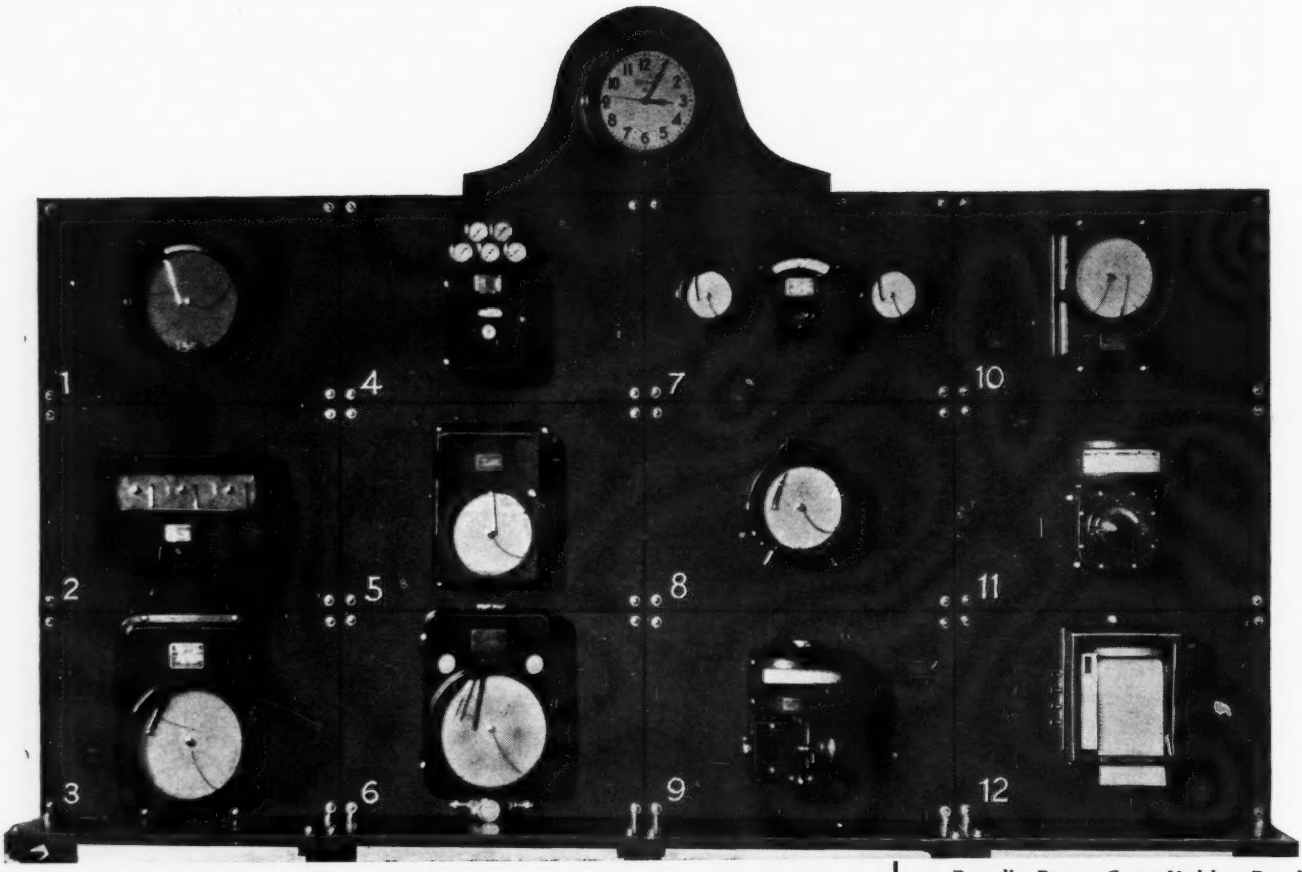
107 public utilities now use 10 or more COPES Feed Water Regulators in their central station plants.

733 Repeat orders for COPES Regulators have been placed by these 107 utilities.

3,078 COPES Feed Water Regulators are now in service in the central stations operated by these 107 utilities.

And in the last three years, these and other utilities have purchased COPES:

Consolidated Gas, Electric Light & Power . . . Michigan Federated Utilities . . . Oliver Power . . . Pennsylvania Power & Light . . . San Antonio Public Service . . . Consumers Power . . . Kentucky-Tennessee Light & Power . . . Canada Electric . . . Brooklyn Edison . . . Fort Churchill Power . . . Kansas Power & Light . . . Oklahoma Gas & Electric . . . Public Service Electric & Gas . . . Central States Electric . . . Connecticut Light & Power . . . Wisconsin Power & Light . . . Elmira Water, Light & Railroad . . . Portland Electric Power . . . New York Steam . . . Consumers Power (Canada) . . . South Carolina Public Service . . . Winnipeg Hydro-Electric . . . Union Gas & Electric . . . Panhandle Power & Light . . . Cheyenne Light, Fuel & Power . . . Buffalo General Electric . . . Illinois Power . . . Southwestern Power . . . Public Service of Oklahoma . . . Philadelphia Electric . . . Commerce Power . . . Southwestern Public Service . . . Jersey Central Power . . . Lake St. John Power . . . Pecos Valley Power . . . Lincoln Power . . . Memphis Power & Light . . . Missouri Power & Light . . . Montana-Dakota Power . . . Public Service of Colorado . . . Northwestern Light & Power . . . Ohio Edison . . . Spokane Central Heating . . . Texas Power & Light . . . Reading Steam Heat & Power . . . Virginia Public Service



To Banish Waste

requires first to detect it

TO promote and preserve plant efficiency loss of all kinds must be banished. At least it must be reduced as much as possible. But before this can even be attempted, such waste must be detected.

BRISTOL'S Instruments enable the engineer to do this. The equipment exhibited is representative of the complete line of BRISTOL'S Recorders and Controllers for the boiler house and power plant that help in ferreting out all irregularities, wasteful fluctuations and costly leaks, and then serve as a valuable aid in making sure that such loss stays out.

Ask to have our engineers call and make a study of your own plant conditions. Put it up to them to show you where you can save money. See what they suggest. There will be no obligation for you to do anything further. Also, send for bulletins describing all of the instruments shown.

THE BRISTOL COMPANY, WATERBURY, CONNECTICUT

Branch Offices: Akron, Birmingham, Boston, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco

TRADE MARK

BRISTOL'S

REG. U.S. PAT. OFF.

PIONEERS IN PROCESS CONTROL SINCE 1889

1. ***Recording Pressure Gauge, Model 43. Round Form, Flush Mounting***
For recording pressures of water, steam, gas, oil, etc.
2. ***Recording Triplex Ammeter, Model 635***
Three separate ammeter movements in one case, each making its own individual chart; but all three charts synchronized and driven from one telechron operated clock. For sub-station work.
3. ***Recording Combination Thermometer and Pressure Gauge. Model 340 MF***
For panels or switchboards in power plant.
4. ***Process Cycle Controller, Model 6035. Single Cam, with Changeable Speed***
For continuous automatic operation.
5. ***Recording Absolute Pressure Gauge, Model 35***
For turbo condensers, vacuum pans, oil stills, vacuum packing and sealing of food stuffs such as coffee and powdered milk.
6. ***Two Pen Full Floating Free Vane Recorder Controller, Model 5240 M***
For recording and controlling humidity, temperature or pressure.
7. ***(Left). Handy Portable Recording Thermometer, Model 144***
For room temperatures.
(Center). Thermometer Controller, Model 177 B
For automatically controlling temperatures of room, ovens, dry houses, etc.
(Right). Recording Humidigraph, Model 4044
For reading direct from chart relative humidities in rooms, dry boxes, refrigerators, etc.
8. ***Recording Thermo-Humidigraph, Model 4069***
Two pen design, one pen reading temperature, the other reading relative humidity. For checking humidity conditions in refrigerators, rooms, etc.
9. ***Pyrometer Controller, Model 479***
For automatically controlling the higher temperatures up to 3000° F. in large industrial gas-fired, oil-fired, or electric ovens, furnaces, etc.
10. ***Recording Voltmeter, Model 540 MF. Flush Mounting***
For main panel or switchboard in power plant.
11. ***Combination Indicating Pyrometer and Rotary Switch, Model 420 C***
For indicating the higher temperatures from 600 to 3000° F. in installations where one instrument is required to indicate temperatures at 10 or 12 different localities.
12. ***Recording Strip Wattmeter, Model 725***
For recording power consumption.

Panel Top: Bristol's Telechron Gangeboard Clock. Flush Mounted

NEWS

a LOW TENSION Rubber Belt

Compensated

PAT. APPLIED FOR

Manhattan engineers — the originators of Condor Belts — announce a new advanced type of transmission belting — the Compensated Belt.

Due to its special, compensated features (patents applied for), the belt performs best at 50% *lower* tension — resulting in longer bearing life, smooth and trouble-free running, and double the overload capacity of standard rubber belt.

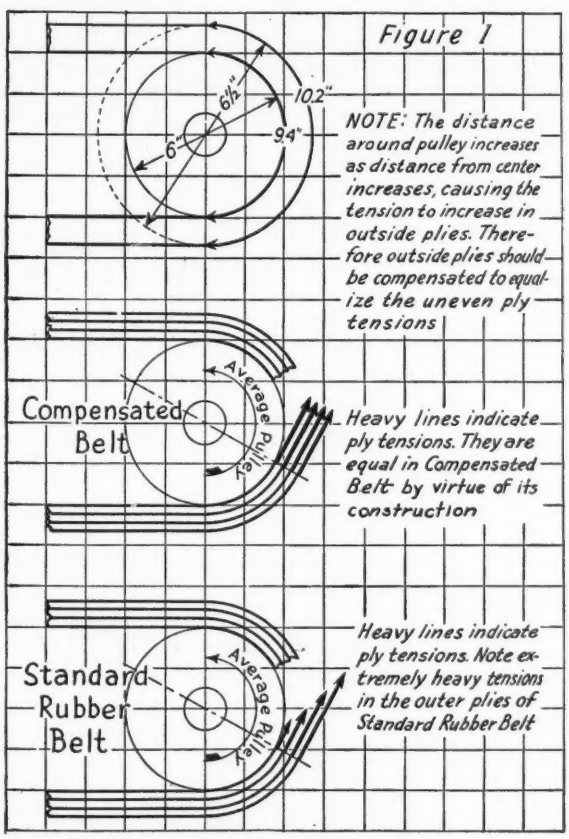


Figure 1
6½"
10.2"
9.4"
6"
NOTE: The distance around pulley increases as distance from center increases, causing the tension to increase in outside plies. Therefore outside plies should be compensated to equalize the uneven ply tensions
Compensated Belt
Average Pulley
Heavy lines indicate ply tensions. They are equal in Compensated Belt by virtue of its construction
Standard Rubber Belt
Average Pulley
Heavy lines indicate ply tensions. Note extremely heavy tensions in the outer plies of Standard Rubber Belt

These diagrams are self-explanatory—study carefully

We cannot urge you too strongly to investigate fully the Compensated Belt. We firmly believe industry will soon acclaim it, as many experts are now doing, as the greatest single advancement in rubber belt construction yet announced.

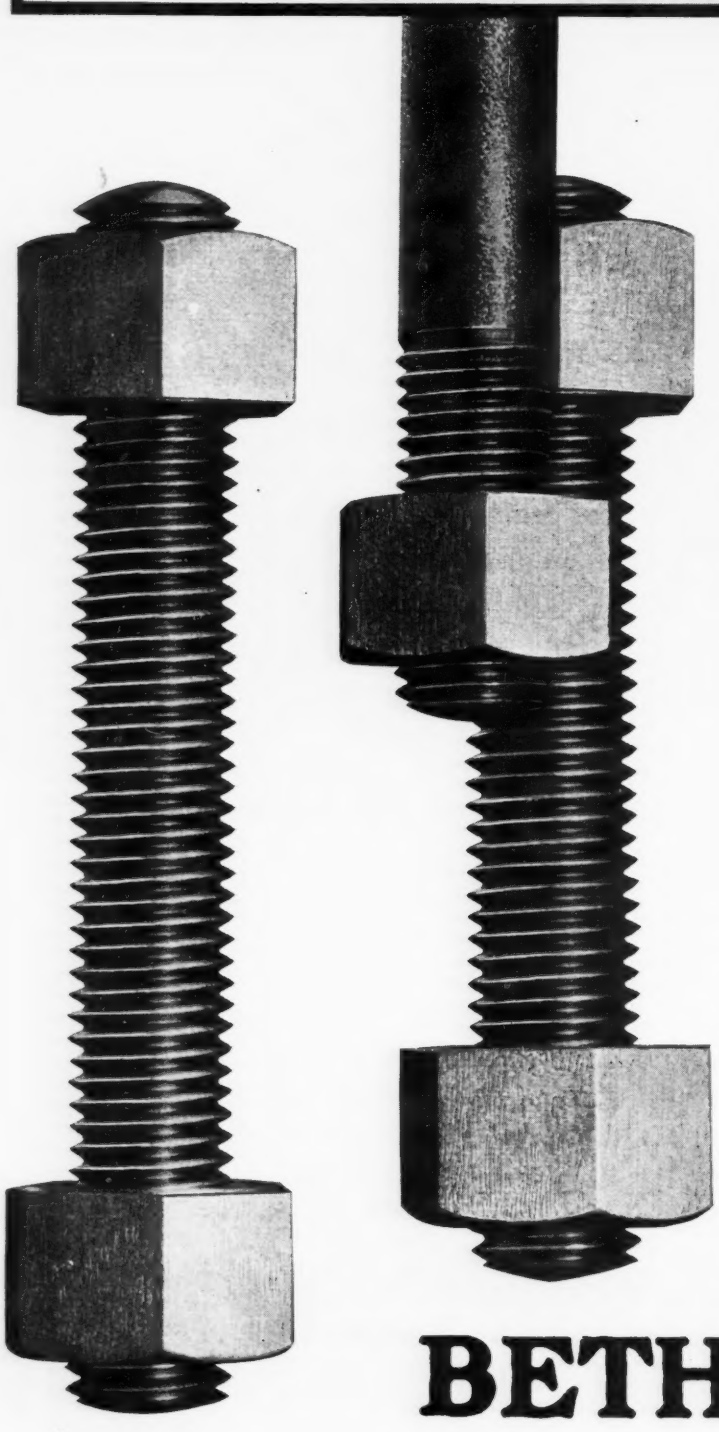
Write for full information

10 Advantages of Compensated Belts

1. Longer fastener life.
2. Higher efficiency when run slack.
3. Higher efficiency on small pulleys.
4. Freedom from ruptures in outside ply.
5. Freedom from wear on pulley side.
6. Freedom from ply separation.
7. Double the overload margin of safety.
8. Higher efficiency under all running conditions.
9. Reduced bearing, shafting, and hanger troubles.
10. Material reductions in belting "costs".

The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc.
Executive Offices and Factories, Passaic, New Jersey

STUDS AND NUTS FOR HIGH TEMPERATURES



MANUFACTURERS and operators of high-temperature high-pressure equipment can use Bethlehem High-Temperature Studs with every confidence in their ability to meet the most exacting requirements. Studs for this class of service can be made from either of the following alloys, developed by Bethlehem especially for applications involving severe stresses at elevated temperatures.

SUPERTEMP — This chrome-tungsten steel is unsurpassed in ability to retain its strength at extremely high temperatures, and in its freedom from creep. For heavy duty at temperatures up to 1100 deg. F. use Studs made of Supertemp.

MAYARI — Studs made of Mayari, a chrome-nickel steel, are thoroughly suitable for heavy duty, at temperatures up to 900 deg. F.

Both Supertemp and Mayari readily meet the A.S.T.M. Standard Specification for High-Temperature Bolting Material A-96-31, Class C. Both these steels can be furnished in Bar Stock.

BETHLEHEM TREATED NUTS and OIL-QUENCHED NUTS

These nuts, hot-forged from open-hearth .40 to .55 carbon steel, are recommended for use with Bethlehem High-Temperature Studs. They are trimmed from a hot forging, and are semi-finished. The forging process used in their manufacture results in nuts of sound, uniform metal throughout; the steel, while in a plastic condition, being forced into the body of the nut.

BETHLEHEM STEEL COMPANY

General Offices: Bethlehem, Pa.

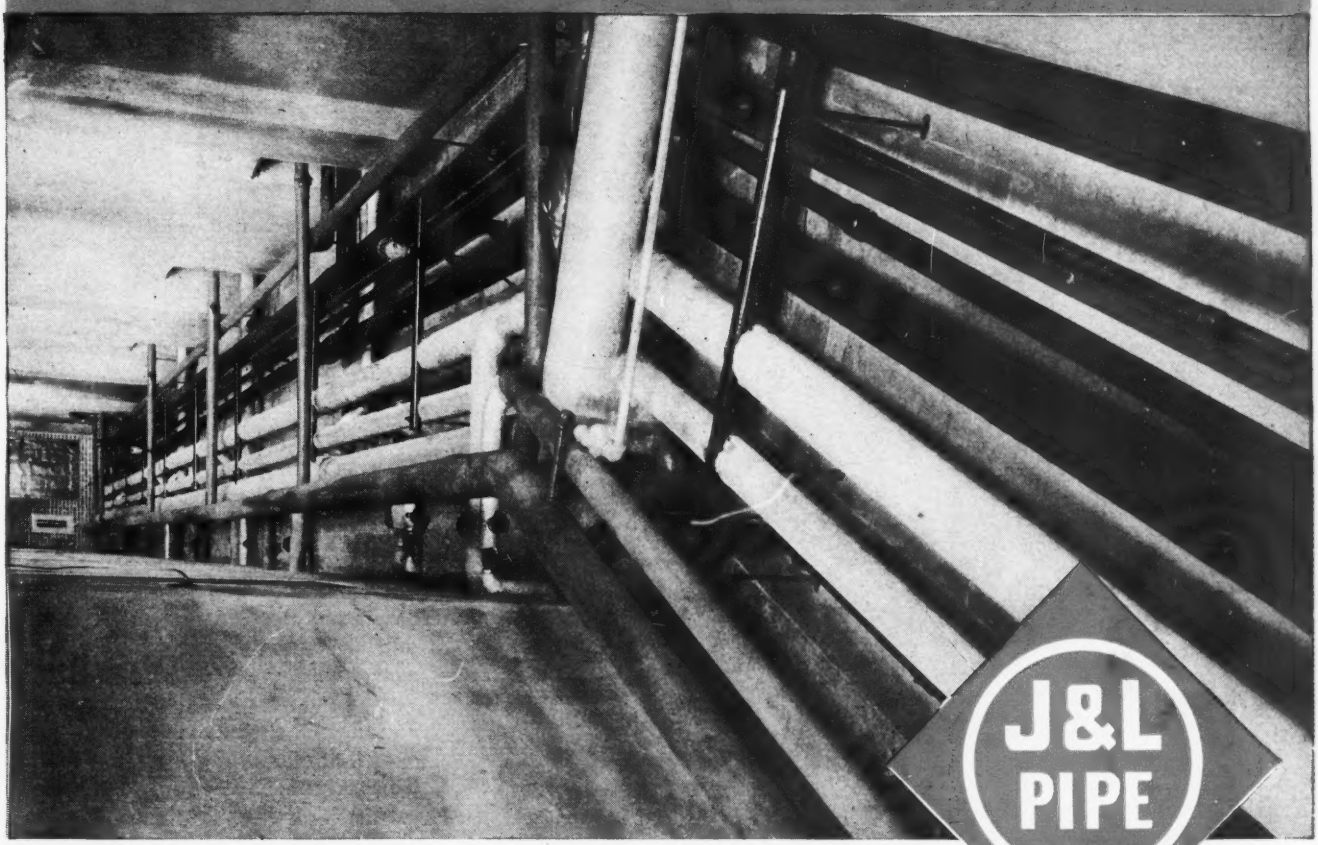
District Offices: New York, Boston, Philadelphia, York, Wilkes-Barre, Baltimore, Washington, Atlanta, Pittsburgh, Buffalo, Cleveland, Cincinnati, Indianapolis Detroit, Chicago, St. Paul, Milwaukee, St. Louis, Houston, Dallas. *Pacific Coast Distributor:* Pacific Coast Steel Corporation, San Francisco, Los Angeles, Portland, Seattle, Honolulu. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM

BETHLEHEM STEEL

J & L STEEL PIPE IS

MADE TO MEET THE REQUIREMENTS OF ALL BUILDING AND INDUSTRIAL PIPING



THERE is the advantage of economy in ordering pipe from one manufacturer who can supply the right kind of pipe for each and every need. J & L manufactures a complete line of steel pipe especially adapted to power plant work, for steam and water piping, for gas and air lines, for sprinkler work, for air conditioning piping and railing work.

J & L Steel Pipe has earned an enviable reputation for excellence, and users everywhere rightly regard the name "Jones & Laughlin," rolled into every length of J & L pipe, as a pledge of complete and lasting satisfaction.

J&L STEEL PIPE IS INSTALLED

in hundreds of buildings situated in cities throughout the entire country. If you would like to see J&L Steel Pipe in actual use in your territory, write us and we will supply a list of installations for you to inspect. There is no obligation.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS

JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

Sales Offices: Atlanta Boston Buffalo Chicago Cincinnati Cleveland Dallas Detroit Erie Los Angeles Memphis Milwaukee New Orleans New York Philadelphia Pittsburgh St. Louis San Francisco

Warehouses: CHICAGO CINCINNATI DETROIT MEMPHIS NEW ORLEANS PITTSBURGH

Canadian Representatives: JONES & LAUGHLIN STEEL PRODUCTS COMPANY, Pittsburgh, Pa., U. S. A., and Toronto, Ont., Canada

J&L STEEL CONSTRUCTION PRODUCTS

LIGHT WEIGHT ROLLED CHANNELS JUNIOR BEAMS STEEL PIPE

STANDARD STRUCTURAL SHAPES STEEL PILING BARS FOR CONCRETE REINFORCEMENT

FABRICATED STRUCTURAL WORK including Steel Plate Construction

GARLOCK 7021

In the last 2 years sales of GARLOCK 7021 have increased almost 600%

For gaskets on pipe lines and other equipment handling gasoline, oil, gas or steam at extreme temperatures and pressures, leading engineers, everywhere, are specifying Garlock 7021 Compressed Asbestos Sheet Packing. One trial will convince you —as it has hundreds of others—that Garlock 7021 is unequalled for severe service conditions.

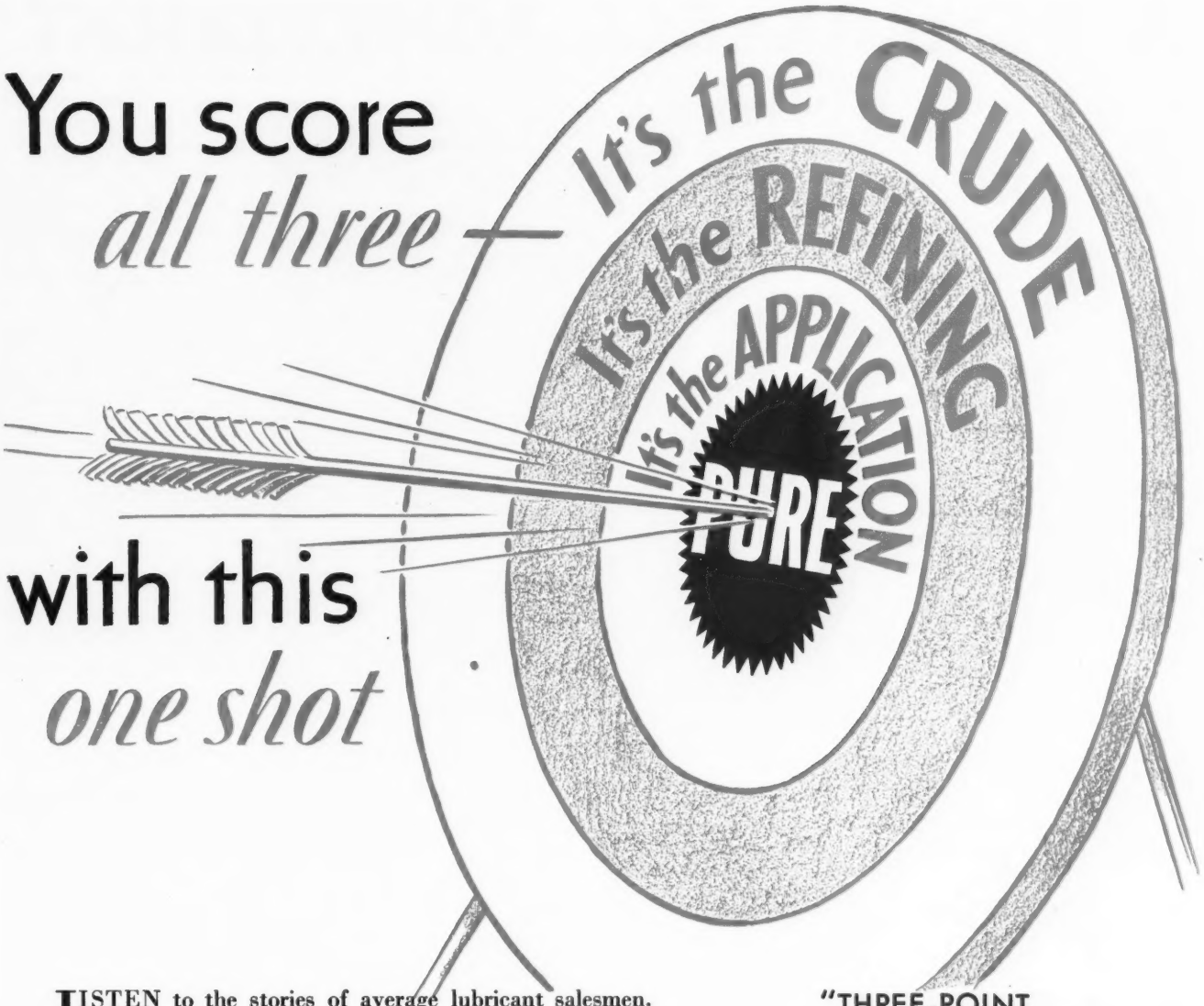
That's Endorsement!

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Company of Canada, Ltd., Montreal, Que.

GARLOCK

You score *all three* — with this *one shot*



LISTEN to the stories of average lubricant salesmen. One tells you impressively about his product's Crude. Apparently he thinks nothing else matters in a lubricant. Another dwells on Refining. A third talks Application and passes over Crude and Refining . . .

Doesn't it stand to reason that each of the three features is equally important? *Why buy one and miss the other two?* You *get all three* in Pure Oil Lubricants.

The three brief pointers at the right explain Pure Oil's "Three-Point" claim to your business. Read those little paragraphs. They've guided thousands to visibly lowered costs, better performance, longer machine life. That's no empty statement. The facts are there, provable. Read, then phone or write a Pure Oil man to come in and give you full details.

"THREE-POINT LUBRICATION SERVICE"

(1) The right kind of CRUDE is important. Some types are better adapted to certain uses than others. Pure Oil Crude comes from many fields in nine states, not from a single area producing only *one* kind of Crude that must be recommended and sold for *every* lubrication need.

(2) Good REFINING is also vital. No Refining process can add missing properties to inferior crudes. But even the best Crude must be correctly Refined to prevent loss of inherent lubricating values. Pure Oil modern Refining methods preserve and *improve* the lubricating qualities of Pure Oil superior Crudes.

(3) Scientific APPLICATION is equally important. Good Crude and good Refining go for naught unless skilled engineering selects the best types of oil for the particular job in question. Pure Oil Engineers are not only lubrication experts, they have had extensive experience in practical plant operation problems.

The PURE OIL *Company*

PRODUCERS, REFINERS AND MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS

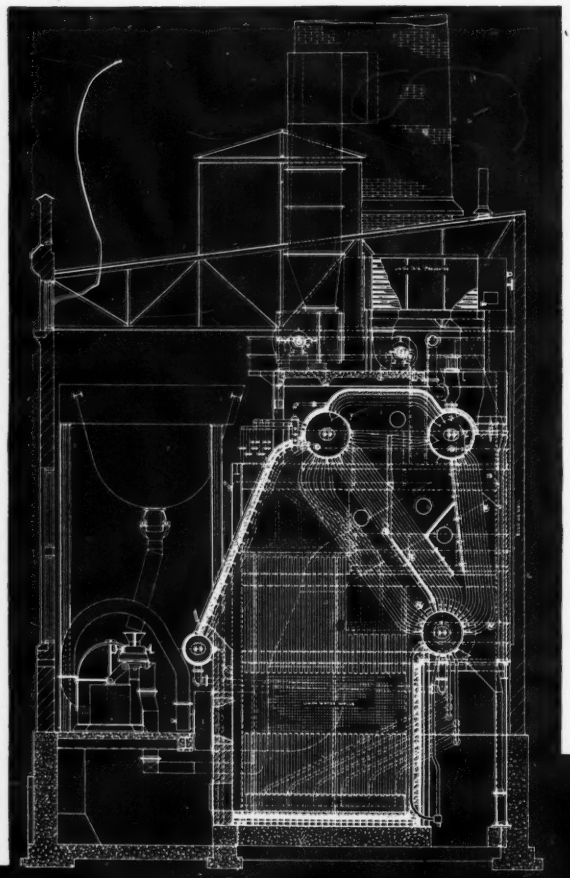
REFINERIES:
Marcus Hook, Pa. Heath, O. Toledo, O.
Muskogee, Okla. Ardmore, Okla.
Smith's Bluff, Texas Cabin Creek Jct., W. Va.

BRANCH OFFICES:
Chicago, Bethlehem, Philadelphia, Wilkes-Barre, Akron, Columbus, Cincinnati, Hamilton, Dayton, Canton, Scranton, Indianapolis, Minneapolis, St. Paul, Pittsburgh, Charleston, Marcus Hook, Wheeling, New York, Newark, N. J., Troy, Utica

(A7355)

A REMARKABLE ACHIEVEMENT★

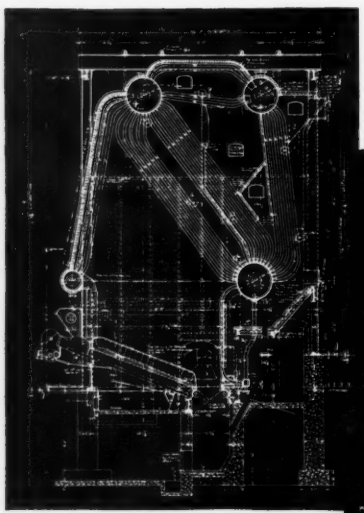
- The Union N-Type Boiler is the outstanding improvement in boiler design.
- The patented Union Front Radiant Heat Element is the correct and logical arrangement of heating surfaces. It exposes more than twice as much surface to radiant heat as in conventional boilers.
- Brickwork is replaced by boiler heating surface and heavy continuous overloads are easily carried with better overall efficiency and minimum furnace maintenance.
- The installations shown have set a new standard for improved all-around performance. They are typical of the better operation of Union N-Type Boilers everywhere. Compare them with ordinary boilers.



NEW YORK CENTRAL RAILROAD CO.
West Albany, N. Y.

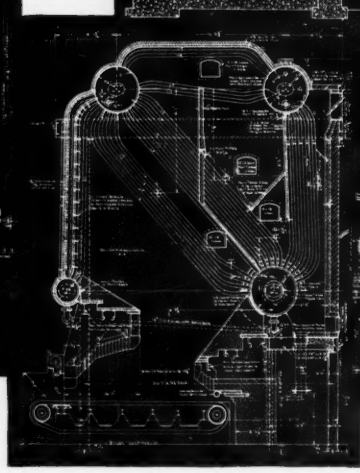
- A high capacity Union N-Type steam generating unit consisting of boiler, water-cooled furnace and air heater designed for 450% rating. All made by Union.
- Complete installation with fuel-burning equipment by the Union Iron Works.

★ These savings can be your savings. It will pay you to investigate. Write us for full information now.



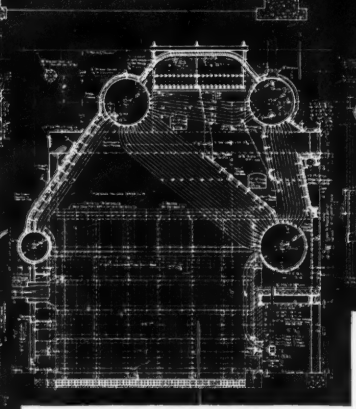
J. L. STIFEL & SONS, INC.
Wheeling, W. Va.

- This 750 H.P. N-Type Boiler replaced two 500 H.P. and four 300 H.P. boilers. In doing the work of six ordinary boilers, this N-Type Boiler saves $28,000 a year in steam cost while producing 23% more steam.



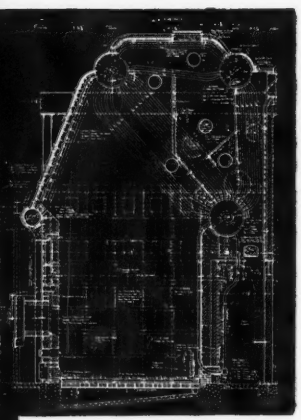
NOTRE DAME UNIVERSITY
South Bend, Indiana

- The four 400 H.P. N-Type Boilers in this model plant, which also is an engineering laboratory, are especially suited for economical utilization of low grade coal at high capacities.



AMERICAN THREAD COMPANY
Willimantic, Conn.

- Three 650 H.P. N-Type Boilers replaced eighteen other boilers. Operating costs were cut 31% and the annual saving is better than 40% of the cost of the new equipment. A complete unit contract by Union.



ROBERT GAIR CO., INC.
N. Tonawanda, N. Y.

- This 750 H.P. 400-lb. N-Type installation has paid for itself out of the savings in operating costs in less than 2 years. Operating close to 300% continuous rating, the daily saving in coal alone amounts to 18 tons. Another Union unit contract.

UNION IRON WORKS

Erie, Pennsylvania

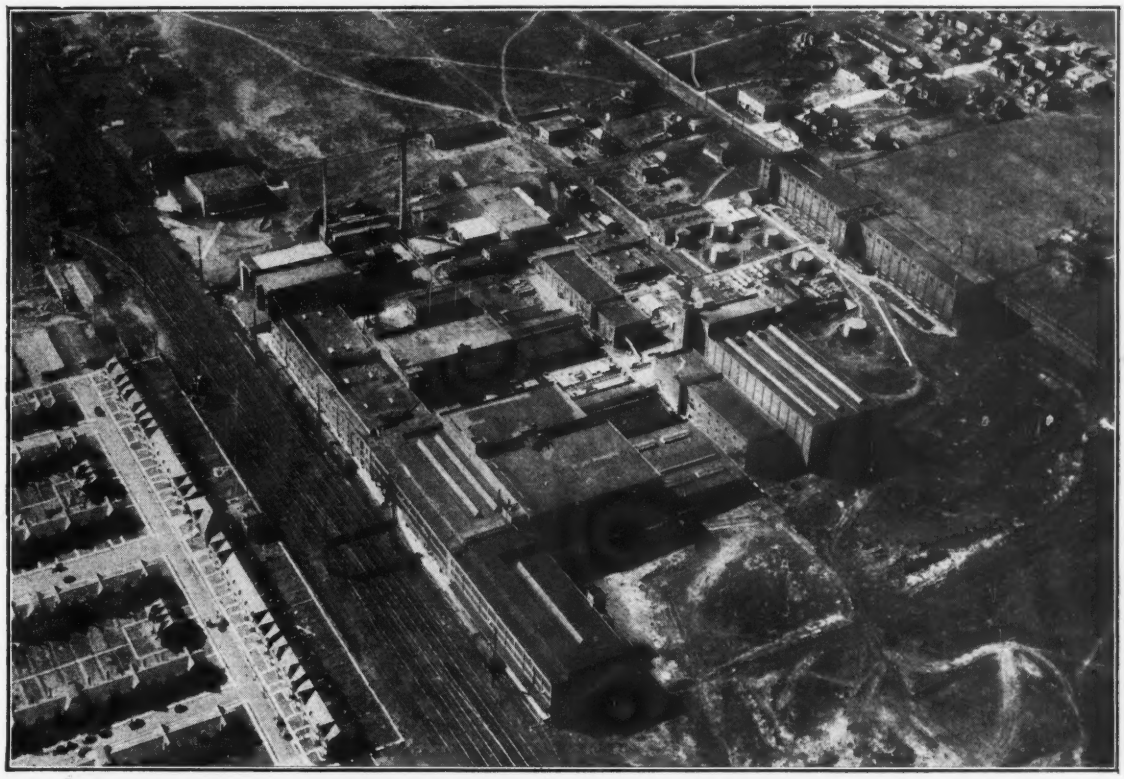
UNION IRON WORKS

BOILERS • WATERWALLS • ECONOMIZERS • AIR PREHEATERS

Congoleum-Nairn, Inc.

(MARCUS HOOK, PA., PLANT)

—are pleased with "SHAWCO" Piping



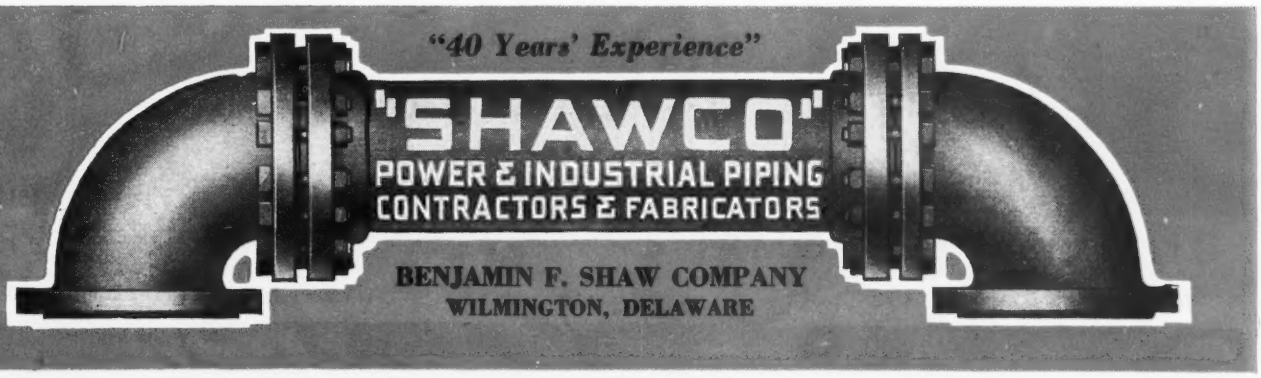
Birdseye view of the Marcus Hook, Pa., Plant of Congoleum-Nairn, Inc.

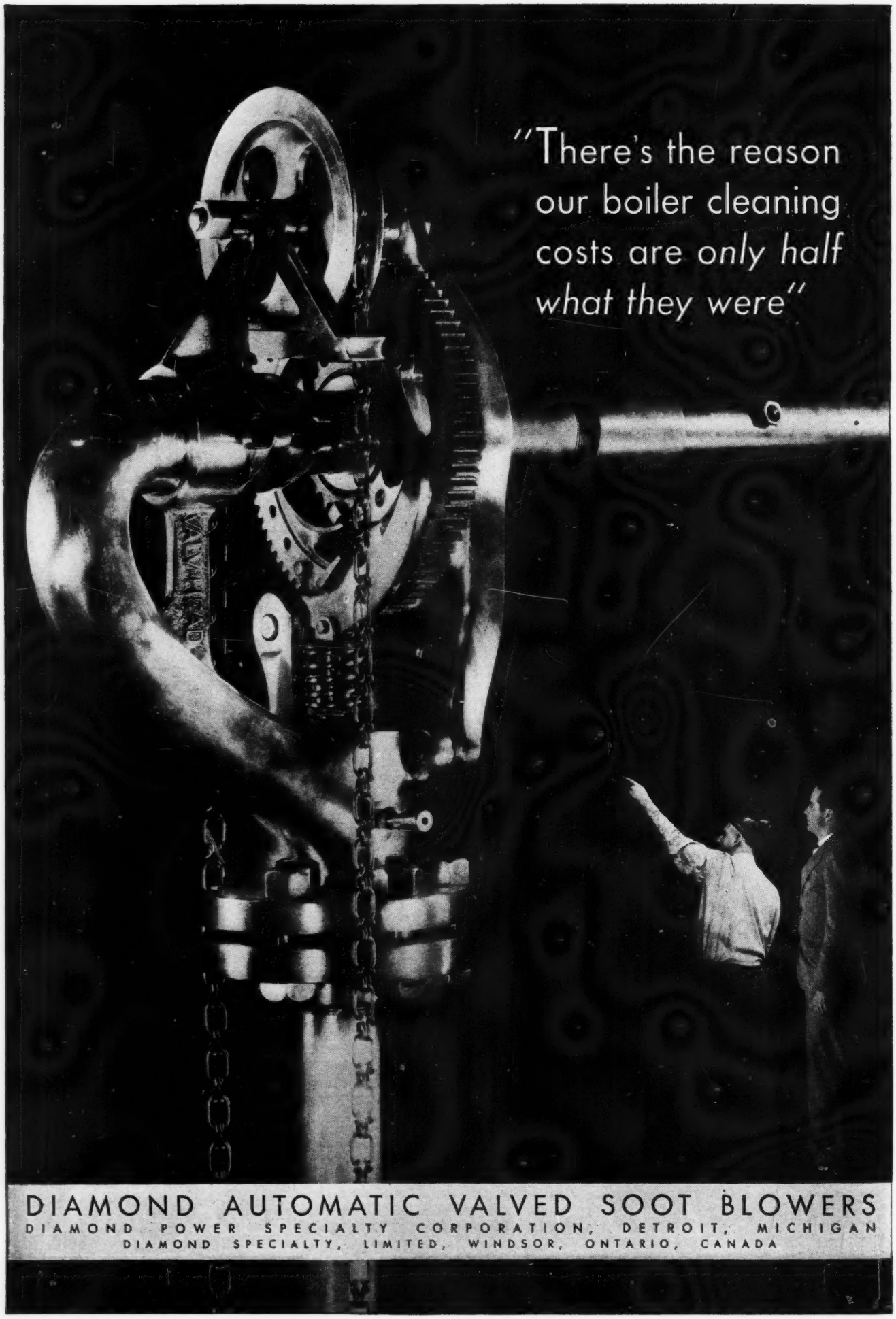
This well known manufacturer of Quality Floor Coverings, like many other prominent Industrial Plants, has put "SHAWCO" PIPING SERVICE to the test,—and has not found it lacking in any respect.

The basic reasons for "Shawco's" growth and success are Quality Materials, Experienced Workmanship, Up-to-date Facilities and Fair Dealing,—regardless of whether the job is large or small.

Every "Shawco" job is backed by 40 years' Experience,—and every job is a "guaranteed" job.

Write for literature and further particulars.




"There's the reason
our boiler cleaning
costs are only half
what they were"
DIAMOND AUTOMATIC VALVED SOOT BLOWERS
DIAMOND POWER SPECIALTY CORPORATION, DETROIT, MICHIGAN
DIAMOND SPECIALTY, LIMITED, WINDSOR, ONTARIO, CANADA

How to Get uniform combustion *and lower fuel bills*

Tear Out and Mail This Memo
Mason Regulator Co., 1190 Adams St., Boston, Mass.
Please send me your bulletin on the Mason Boiler Control Instrument No. 6600.
SIGNED .....
COMPANY .....
ADDRESS .....

You can now hold your boiler pressure constant within a fraction of a pound. You can synchronize the fuel supply with the draft fan or damper. And you can maintain combustion efficiency — *with a single instrument.*

The instrument is the new Mason Boiler Controller No. 6600.

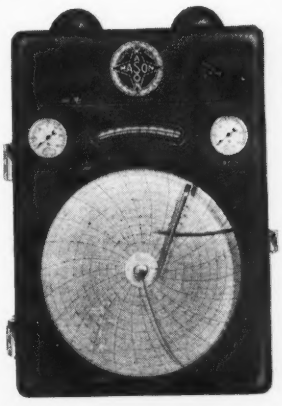
This Mason Controller is sensitive to pressure changes before they appear on the steam gauge. It actually prevents the variations that are required to operate less sensitive devices. Yet, due to a special compensator, it cannot hunt, cycle or overcontrol. If you are using coal, a sudden drop in boiler pressure can never cause your blower to race and shoot your fire bed full of holes. Instead, the Mason No. 6600 provides *alert* control that means lower fuel bills, even firing and uniformly efficient combustion.

What's more, this new Mason No. 6600 is really two instruments in one. It controls the boiler pressure and at the same time inscribes a chart record of it.

The Mason Boiler Control Instrument is designed to control the supply of fuel oil, the speed of a stoker engine, the stack damper, the forced or induced draft blower — or any combination of these — *precisely.*

The coupon above brings you the whole profitable story. Send it—NOW!

Mason Boiler



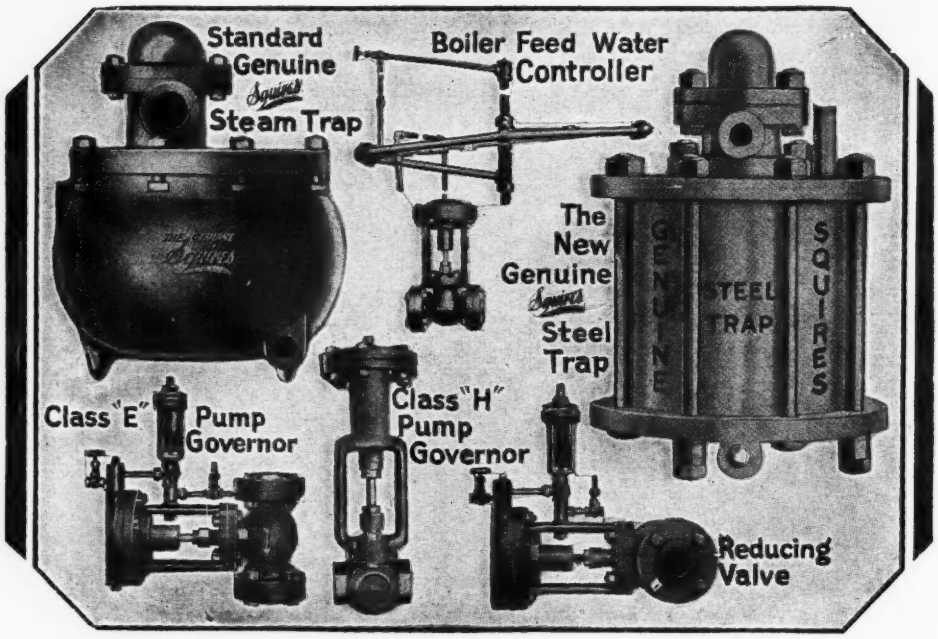
Controller No. 6600

Mason Control

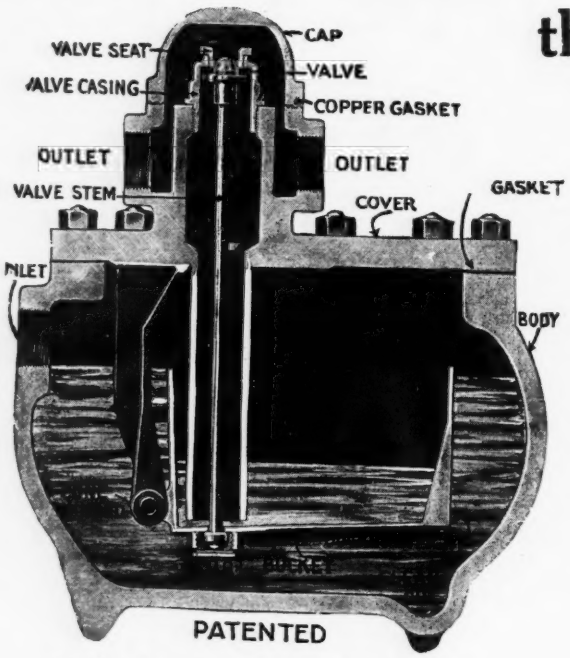
A Half-Century of Service to the Power and Process Industries 1882-1932

5550

Send for Catalog A for full information about these Specialties


Standard Genuine Squires Steam Trap
Boiler Feed Water Controller
The New Genuine Squires Steel Trap
GENUINE STEEL TRAP SQUIRES
Class "E" Pump Governor
Class "H" Pump Governor
Reducing Valve

Install SQUIRES Specialties



Interior view of the Standard Genuine Squires Steam Trap. Parts are accessible for inspection or change without breaking pipe connections. Cast iron bucket is hinged by means of tapered bearings to an open bronze bearing. No floats, no levers, no joints to fill with dirt in this trap. Valve cannot be displaced; stem never requires packing.

they'll help cut operating costs to the bone

You'll find the notably trouble-free, heat-saving service of Genuine Squires Specialties a decided help in your present effort to trim operating costs to the bone.

Genuine Squires Traps, covering the entire range of trapping requirements, and the other Squires Specialties have been in use in the country's outstanding central stations and industrial plants for the last thirty years.

Squires Pump Governors include a type for every service; Reducing Valves give exact reductions from highest pressures to any low pressure desired; Boiler Feed Controllers help boilers to give increased efficiencies.

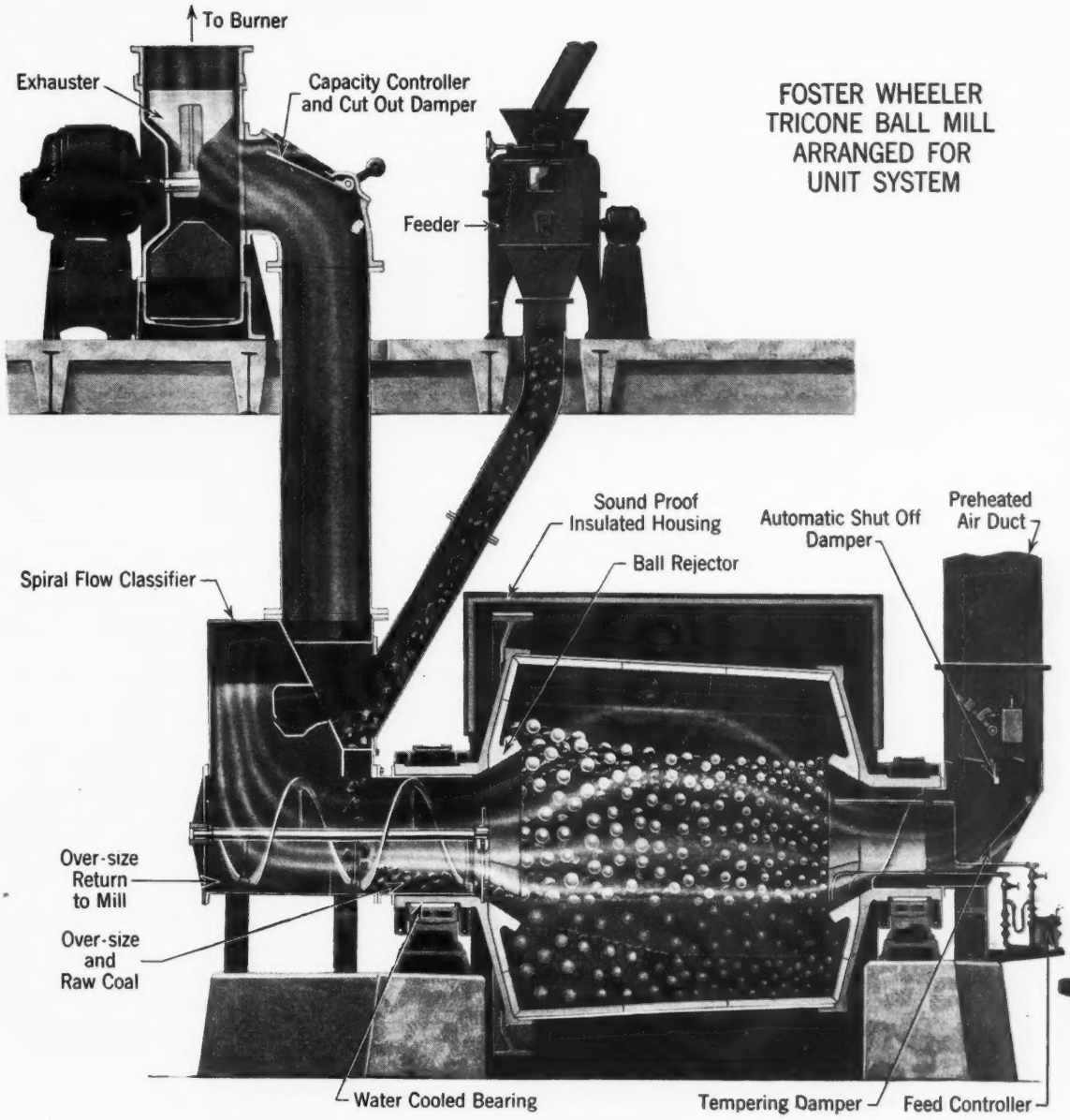
Write today for the details about these Specialties. The quick and certain way to benefit by ALL the steam that's being paid for is to use Genuine Squires.

Insist on the Genuine Squires

Steam Specialties

THE C. E. SQUIRES COMPANY

E. 40TH ST. & KELLEY AVE., CLEVELAND



FOSTER WHEELER TRICONE BALL MILL ARRANGED FOR UNIT SYSTEM

Improved Pulverizers

The newly developed Tricone ball mill as offered by Foster Wheeler for both unit and storage systems represents notable advancements in the art of fuel preparation.

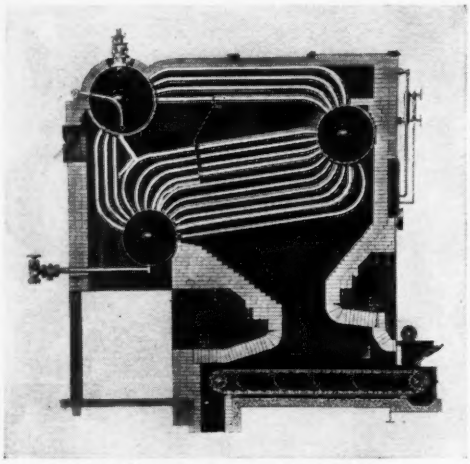
This mill is designed to deliver fuel as required for steam plant operation, without time lag. The shape of the mill is such that both coal and balls are classified within the mill according to size, effecting maximum pulverizing efficiency. Counter current air and coal circuits eliminate the usually detrimental effects of free surface moisture on pulverizing efficiency.

Details of the Tricone mill may be had upon request.

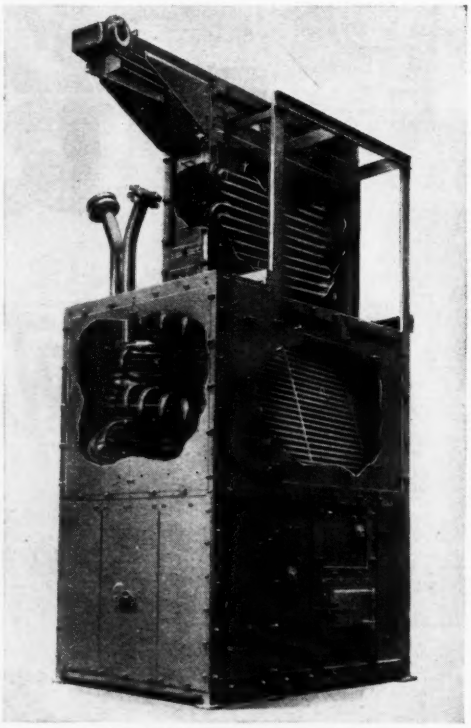
FOSTER WHEELER CORPORATION
165 Broadway New York

FOSTER WHEELER

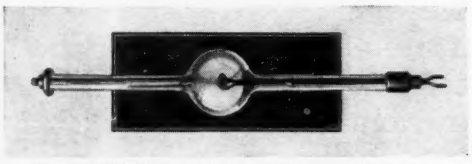
ACHIEVEMENTS of 1932



Total small-boiler heating surface passes one-million-square-foot mark.



Babcock & Wilcox Diphenyl Boiler enters successful service.



First 300,000 volt X-ray equipment installed.

One of the world's largest Bubble Towers delivered.

THE Babcock & Wilcox Boilers, Superheaters, Economizers, Air Heaters, and Bailey Water-Cooled Furnaces ordered for the new Washington, D. C., Station of The Potomac Electric Power Company constitute the largest order for this type of equipment placed this year. The latest refinement in B & W Light-Weight Insulated Casing is one of many features of this installation of modern power-plant equipment.

From coast to coast, installations of small moderately-priced Type H Stirling Boilers, introduced in 1929, now have a total of more than 1,000,000 square feet of heating surface.

To date, orders for more than 455 boiler drums with welded seams provide convincing evidence of Babcock & Wilcox leadership in fusion-welding.

The scope of the Babcock & Wilcox Fusion-Welding Technique has been materially extended by the installation of the first 300,000 volt X-ray equipment and the construction of one of the largest stress-relieving furnaces at the company's Barberton, Ohio, Works.

The Company was awarded the contract for the fabrication and installation of more than 14,000 feet of welded plate-steel pipes for the hydraulic-power and flood-control tunnels at Hoover Dam. Most of these pipes will be 30 feet in diameter, up to 2⅞ inches in thickness and will weigh 150 tons per erection-section . . . the largest ever constructed.

A new wall structure developed by the Company for water-cooled furnaces demonstrated its ability to withstand the severe operating conditions encountered in central station service. This new Bailey Stud Tube Wall is a worthy companion of the Bailey Block-Covered Water-Cooled Furnace.

A new high-capacity record was established by a Babcock & Wilcox Type B Pulverizer by pulverizing over 50 tons of coal per hour at the Kip's Bay Station of the New York Steam Corporation.

Another Babcock & Wilcox Pulverizer reduced the power consumption for raw-material grinding by 47 per cent in regular cement-plant operation.

One of the world's largest Bubble Towers was erected in 1932 at Bayonne, New Jersey. This tower, built by Babcock & Wilcox, is 93 feet high, and weighs more than 325,000 pounds.

An important installation of a mercury boiler and mercury-vapor heat-transfer equipment was made in a large chemical plant . . . equipment containing many new and advantageous features of design and operation.

At Marcus Hook, New Jersey, the use of diphenyl as a heat-transfer medium in a special boiler built by this organization met with marked success in one of the country's largest industrial establishments. The Company is also prepared to build boilers for use with diphenyl oxide and Dowtherm as heat-transfer mediums.

The greatest advance in sulphite cooking in recent years was made in the Kimberly Mill of the Kimberly-Clark Corporation with equipment built by Babcock & Wilcox. This digester control system, now marketed by The Babcock & Wilcox Company, improves the quality of the pulp, raises the pulp yield, increases the output of the digester, and reduces the consumption of sulphur, lime, and steam.

Unprecedented savings of 48.5 per cent in fuel per cycle and 89 per cent in the time required to bring a high-speed heat-treating furnace to operating temperature were secured through the installation of B & W No. 80 Insulating Firebrick . . . savings duplicated or exceeded in many other installations.

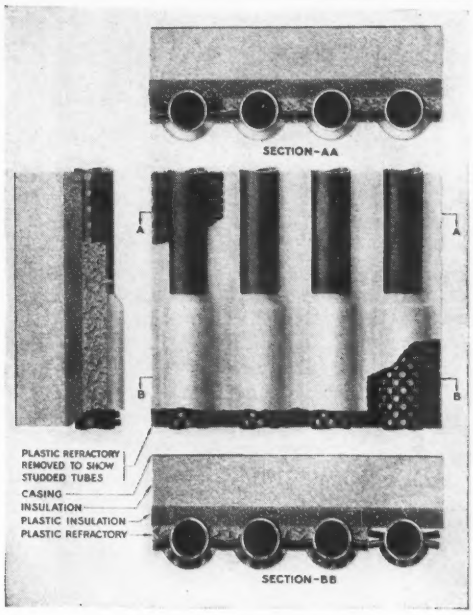
The majority of ships launched in this country in 1932 contain Babcock & Wilcox Marine Equipment . . . definite assurance of economical and thoroughly dependable service.

These achievements of The Babcock & Wilcox Company in 1932 reflect the company's progressiveness and continuing leadership.

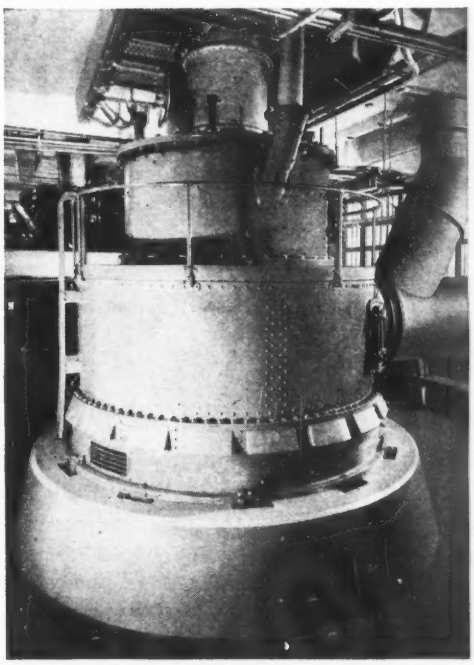
The Babcock & Wilcox Company . . . 85 Liberty St. . . . N. Y.

BABCOCK & WILCOX

G-27-T

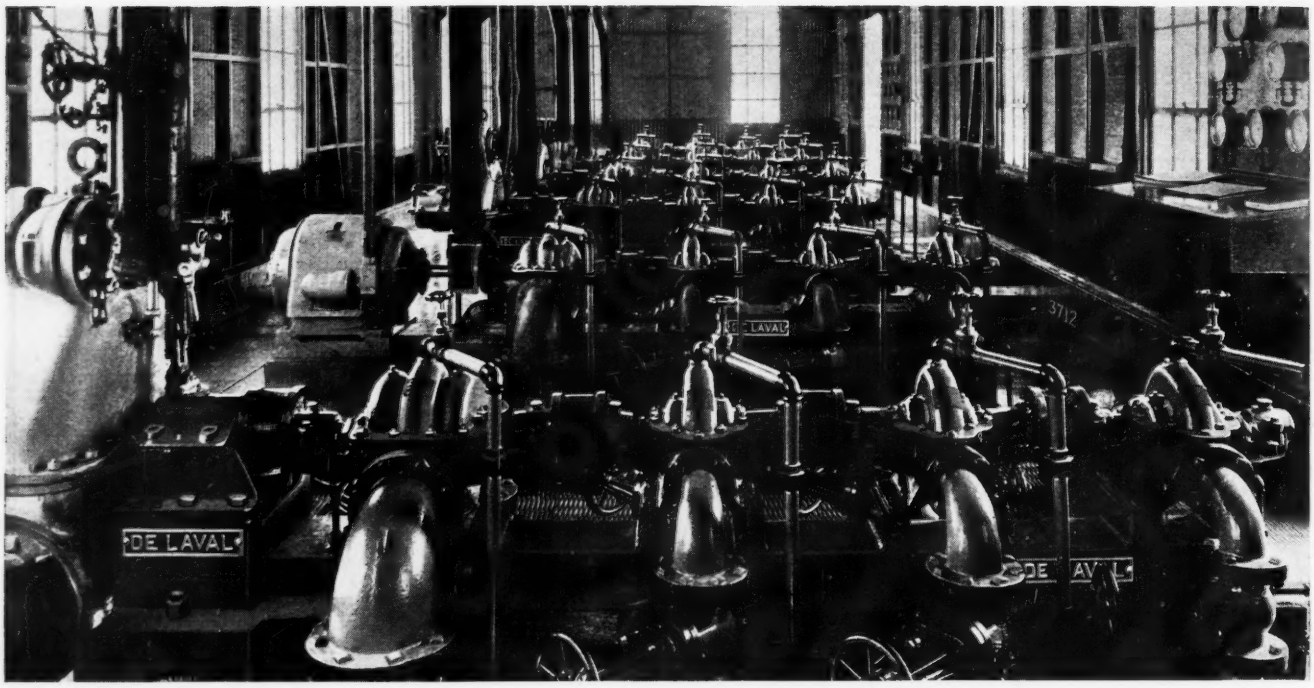


Stud Tubes, a new water-cooled furnace-wall structure, developed.



Babcock & Wilcox Pulverizer sets new capacity record.

World's largest pipe will be installed in this and three other tunnels at Hoover Dam.



The bigger the pumping job— the more reason for De Laval Pumps

THE absorption plant of the Barnsdall Oil Co., of which one of the pump houses is here shown, uses altogether some 65 De Laval pumps.

The six sets in the photograph are each made up as follows:

The pump adjacent the turbine or motor supplies 1000 gallons of water per minute against 30 pounds pressure;

The second pump handles 200 g. p. m. of 140° F. absorption oil against 78 pounds;

The third pump handles 210 g. p. m. of 90° F. absorption oil against 55 pounds;

The fourth pump forces 60 g. p. m. of 90° F. gasoline against 30 pounds.

Four of the sets are driven by De Laval Velocity Stage Steam Turbines, the exhaust of which is applied in the process; while the two remaining are motor driven. These units have been in continuous service since 1928 and 1929, and are reported to have given very good service.

These units are designed, built, assembled and guaranteed by one and the same organization.

De Laval Steam Turbine Co.

Trenton, New Jersey

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Boston
Charlotte
Chicago
Cleveland
Duluth
Edmonton, Alberta
Havana
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Honolulu, H. I.
Houston
Kansas City
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LOCAL OFFICES

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New York
Philadelphia
Pittsburgh
St. Paul
Salt Lake City
San Francisco
Seattle
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Manufacturers of Steam Turbines, Centrifugal Pumps, Propeller Pumps, Rotary Displacement Pumps, Centrifugal Blowers and Compressors, Double Helical Speed Reducing Gears, Worm Gears, Hydraulic Turbines, Flexible Couplings and Special Centrifugal Machinery 3140

Reports of Power Show and A.S.M.E. and A.S.R.E. meetings. Annual Equipment Review

POWER

Volume 76 Number 7

Mid-December, 1932

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INDUSTRY today is buying new equipment only upon evidence of tangible savings . . . new equipment must pay its way.

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3 . . . Sump pump . . . for all types of drainage service. Made low in cost through standardized parts design.

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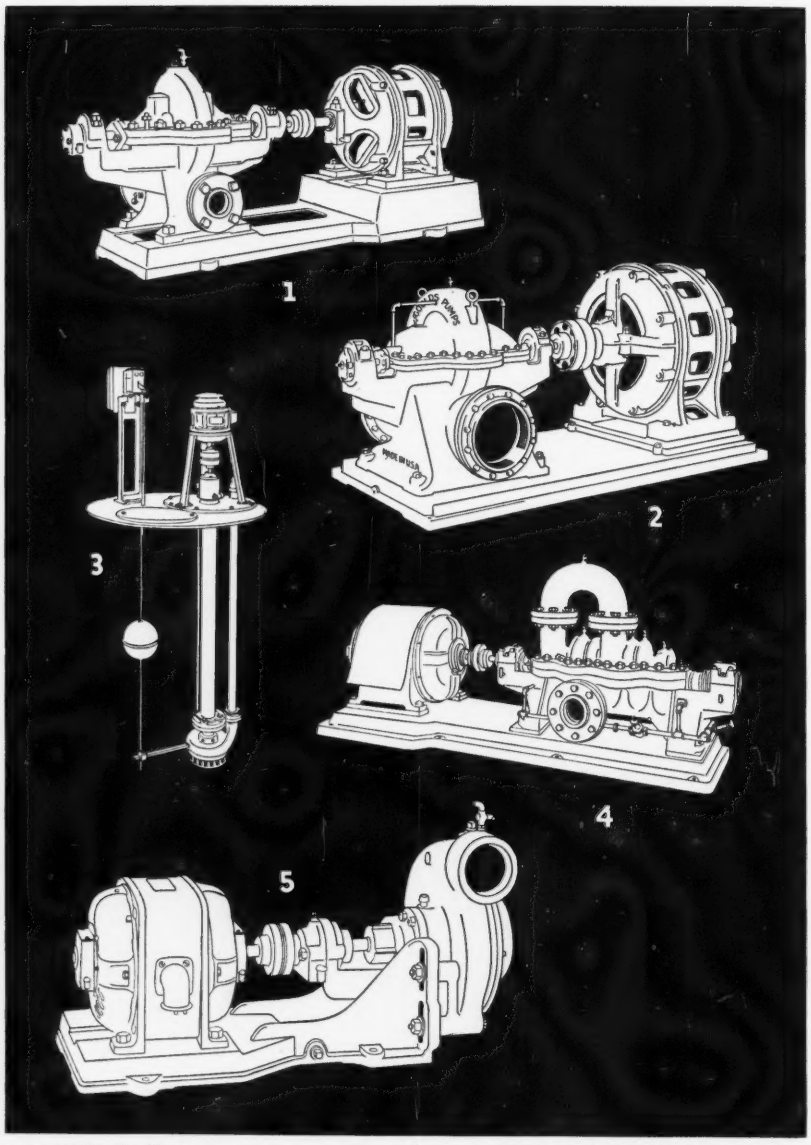

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IS THE BELT FOR THOSE FAST SEVERE DRIVES

THERE never was a belt that has registered such immediate and lasting success on fast severe drives as this new Goodyear THOR Belt, seamless*.

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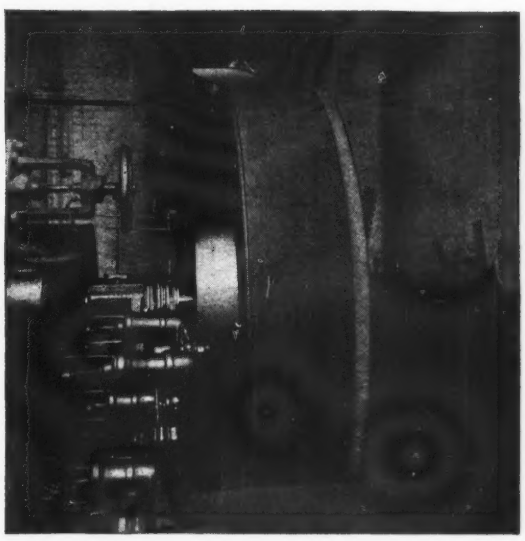
Why not talk over your requirements or equipment problems with the G.T.M.? A word to Goodyear, Akron, Ohio, or Los Angeles, California, or your nearest Goodyear Mechanical Rubber Goods Distributor, will bring him.



* *Goodyear* THOR *Belting, seamless is made in widths up to and including 16"—*THOR *quality of special construction is available for larger sizes*

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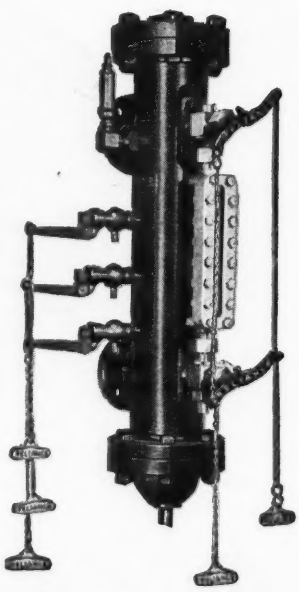
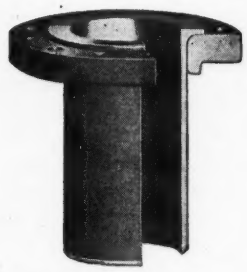
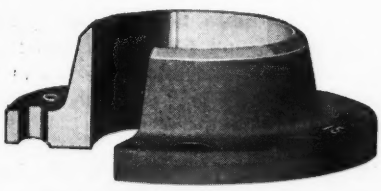


Reliance High and Low Alarm, Forged Steel No. 73 for pressures to 750 lbs.

CRANE welding materials offer ample factors of safety



Combination of No. 574 Cranelap welding nipple and No. 572 Cranelap Flange.



No. 568 Series 15 Welding Neck Flange.

No. 353-E Tee. 1" to 10"

SO that engineers can have the assurance that every fitting used in a welded piping installation will be as strong as every other unit in the installation, Crane Co. has placed comprehensive pressure and temperature ratings on its welding materials.

These ratings are based on conservative factors of safety and can be relied on with the utmost confidence. For actual tests have proved, as an example, that the new Crane seamless welding elbow has a bursting strength in excess of that of the tubing from which it is made.

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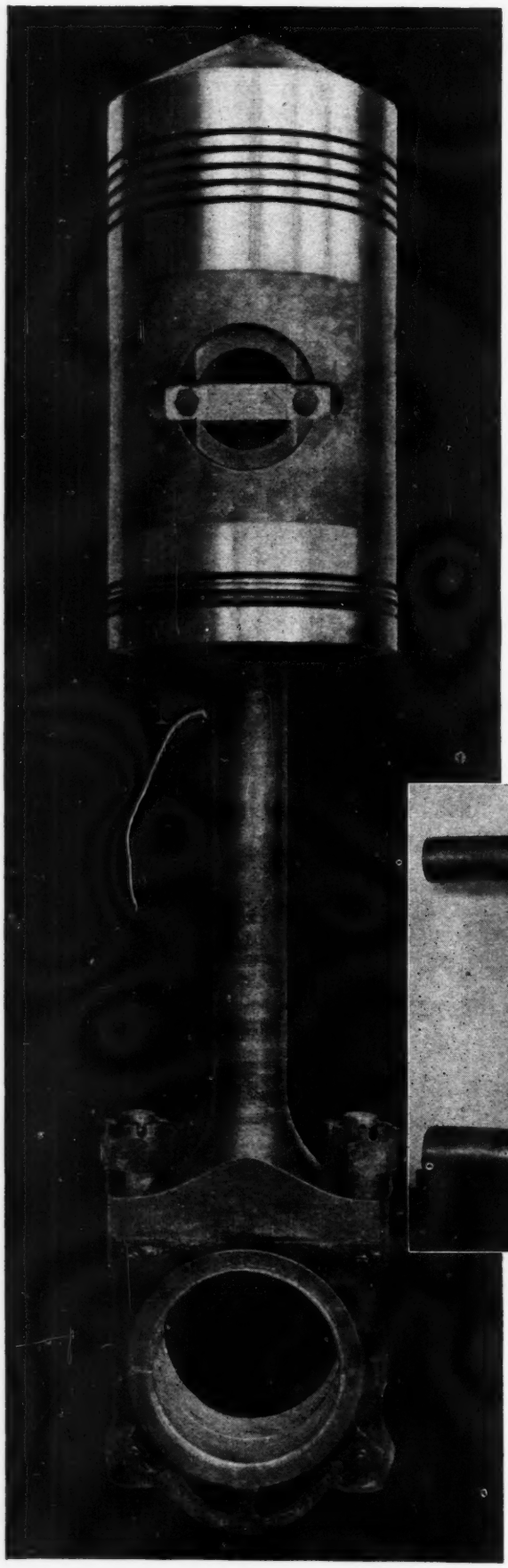
PIPING MATERIALS TO CONVEY AND CONTROL STEAM, LIQUIDS, OILS, GAS, CHEMICALS

REASONS *for* DE LA VERGNE SUPERIORITY



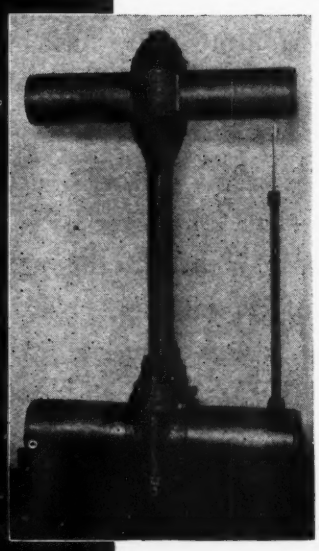
THE PISTON—CONNECTING ROD ASSEMBLY . . .

where precision reduces vibration and wear

Superior performance of any machine is merely the reflection of excellence in every contributing detail.

Skillful designing, the selection of metals perfectly suited for the construction of each part and precision workmanship of a high order go into the De La Vergne Diesel—the most thoroughly developed Diesel engine in the world.

Consider the piston—connecting rod assembly, for instance. The pistons are made of ELFUR Iron, especially suited to long life under temperature conditions encountered in such service. They are finished in grinding machines to a high degree of accuracy. These pistons are of the trunk type with extra long skirts insuring low side-pressures. Piston heads are cone shaped, permitting maximum expansion and contraction of the head with a minimum of internal stress. De La Vergne pistons, because of their shape and because of advantages inherent in the system of combustion, do not require complicated water or oil cooling and attendant maintenance, in sizes up to 22-in. cylinder diameters.



Wrist pins are machined hollow from special steel, case hardened and finished by grinding. Very liberal wrist pin dimensions are provided, and arrangements made for positively locking the wrist pin in position.

Connecting rods are made of open hearth, high carbon steel forgings. The wrist pin end is machined from the solid stock to receive a two-piece bronze adjustable wrist pin box. The lower end is flanged and bolted to the crankpin bearing, which is of marine construction.

Both the wrist pin and crankpin bearings are scraped to standard mandrels, and their alignment is checked by micrometers and V-blocks.

This assurance of positive accuracy of alignment in the piston-connecting rod assembly accounts for much of the De La Vergne engine's reputation as the quietest, smoothest running, most dependable Diesel Engine ever built.

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SALES AGENT FOR BALDWIN-SOUTHWARK CORP.
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STEAM TRAPS

OPEN AND INVERTED BUCKET—SEMI-STEEL, CAST AND FORGED STEEL

For more than a quarter of a century the Strong Steam Trap has been known as the trap that will not leak, the trap that will not air-bind, the trap that has *adequate* capacity.

Strong Traps, upright and inverted bucket types, are used today in every known industry, and operating under pressures of 10 lbs. or less to 1,000 lbs., a size and type for every requirement.

All Strong Traps, except the low pressure types, are fitted with "Anum-Metl" valves and seats, and that's why they don't leak or wire-draw. This is an exclusive Strong feature.

Capacity of Strong Traps always exceeds their rating, and consequently, as a rule, fewer Strong traps are required to do the job.

Another exclusive and patented feature is the Strong Anti-Balancing and Self-Cleaning Hinge, used on all Strong Inverted Bucket Traps.

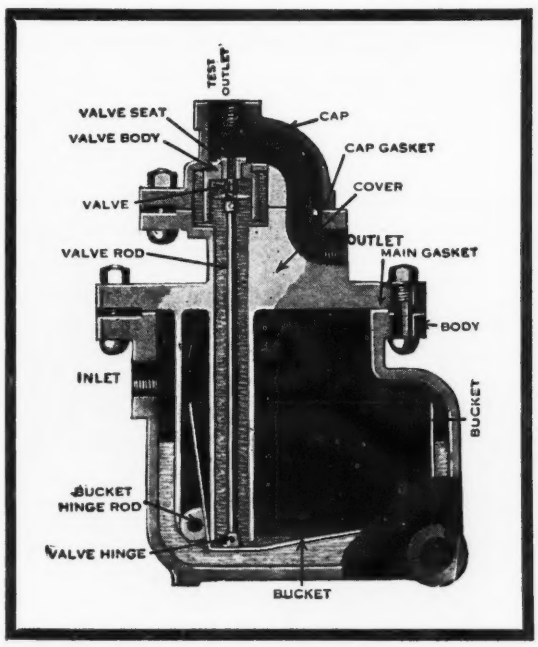
This device has been proclaimed as the most important improvement in steam trap design in years, and another tribute to the designers and builders of Strong Traps.

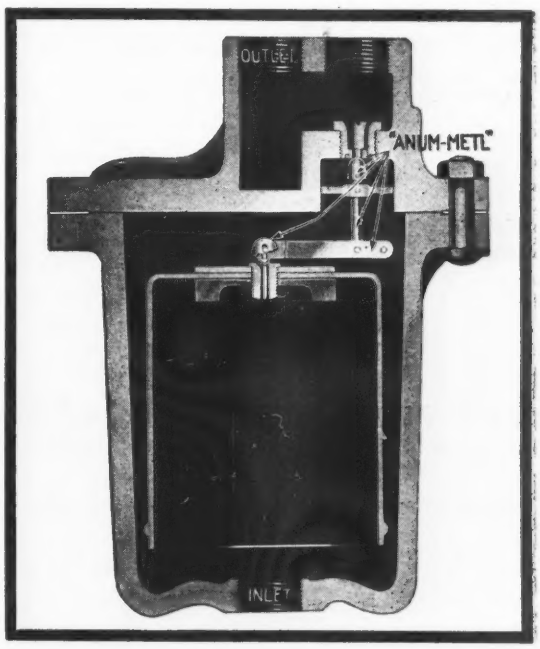
We believe this device has done more to popularize the inverted bucket trap than any other one feature.

Trends and changes in steam processing have been rapid in recent years. Strong Traps have kept pace with these new demands.

***Your* Strong Steam Trap will be guaranteed for one year against defects of any kind. *Your* Strong Steam Trap may be returned, without any cost to you, within 3 months after purchase if it does not do all a steam trap can do.**

Illustrated bulletins will be sent on request. These also describe the Strong Anti-Balancing Device used on Inverted Bucket Traps. Write—





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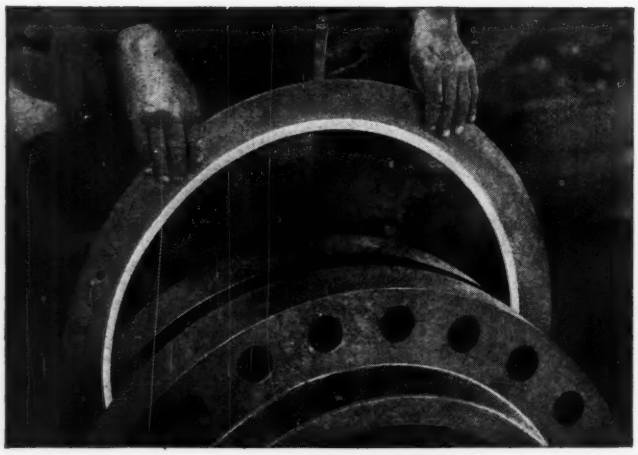
1392 West Third Street **Cleveland, Ohio**

New products that reduce space requirements and maintenance cost of Power Piping



KELL-RAPH COPPER PLATED GASKETS

Kell-Raph Gaskets were developed to meet the new operating conditions incident to high pressure and high temperature pipe lines.

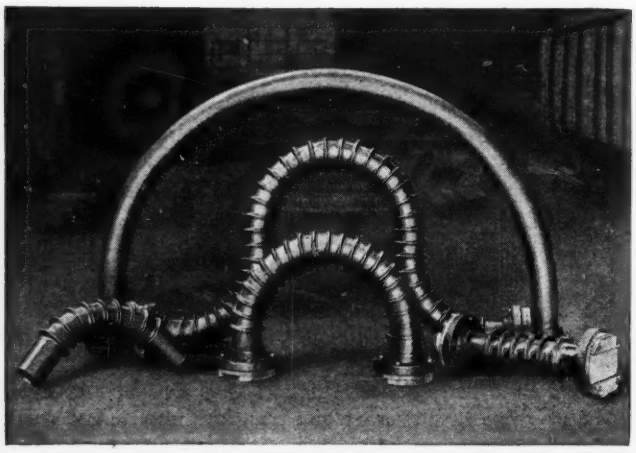
Kell-Raph Gaskets—will remain tight under any temperature.

Kell-Raph Gaskets—are easy to install.

Kell-Raph Gaskets—can be re-used several times when fitting changes are necessary.

Kell-Raph Gaskets—will withstand the most severe conditions incident to high pressure and high temperature operation.

Kell-Raph Gaskets—due to their superior design and construction have given excellent service under the most severe operating conditions.



KELLOGG CORRUGATED EXPANSION BENDS

Kellogg Corrugated Expansion Bends supply the need of greater flexibility in solving the piping problems of high pressure, high temperature generating stations.

Kellogg Corrugated Bends—are four to five times as flexible as plain pipe bends.

Kellogg Corrugated Bends—reduce the amount of space required for expansion bends to a minimum.

Kellogg Corrugated Bends—reduce the strain on joints preventing possible leakage from this cause.

Kellogg Corrugated Bends—will care for the lineal expansion of a much longer run of pipe than a plain bend—with no increase in joint stress.

THE M. W. KELLOGG COMPANY · 225 BROADWAY, NEW YORK

Birmingham, 827 Brown-Marx Building; Boston, 12 Pearl St.; Chicago, 1 La Salle St.; Los Angeles, 742 Western Pacific Building; Tulsa, Philtower Building

KELLOGG

Kellogg products include Cross, Holmes-Manley, deFlorez and Tube and Tank cracking units, absorption plants and pipe stills. Pressure vessels for the Power, Refinery and Chemical Industries. Power plant and Industrial piping. Pacific Hot Oil Pumps, Radial brick chimneys. Plastic Refractories.

STANDARDIZE ON LUNKENHEIMER

Fig. 1720

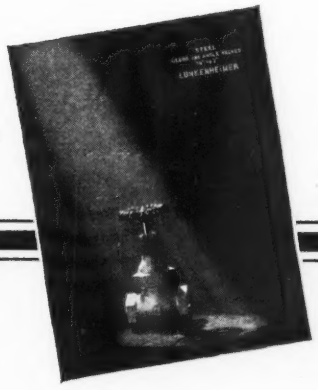
600 lb. STEEL

Globe Valve

This Lunkenheimer design reflects a pronounced advance in the construction of steel valves of the inside screw type—a Bonnet-Thread-Bushing, made of an alloy selected primarily for its wear resisting properties at high temperatures. This construction, together with the specially heat treated stainless steel seat and disc should commend the valve to any user of inside screw steel globe valves.

Globe and angle patterns, screwed or flanged, with Full-way or Throttling type seats and discs are available in sizes up to 2 inches. Recommended for steam pressures up to 600 pounds at 750 degrees.

Descriptive booklet F. 591 sent on request.



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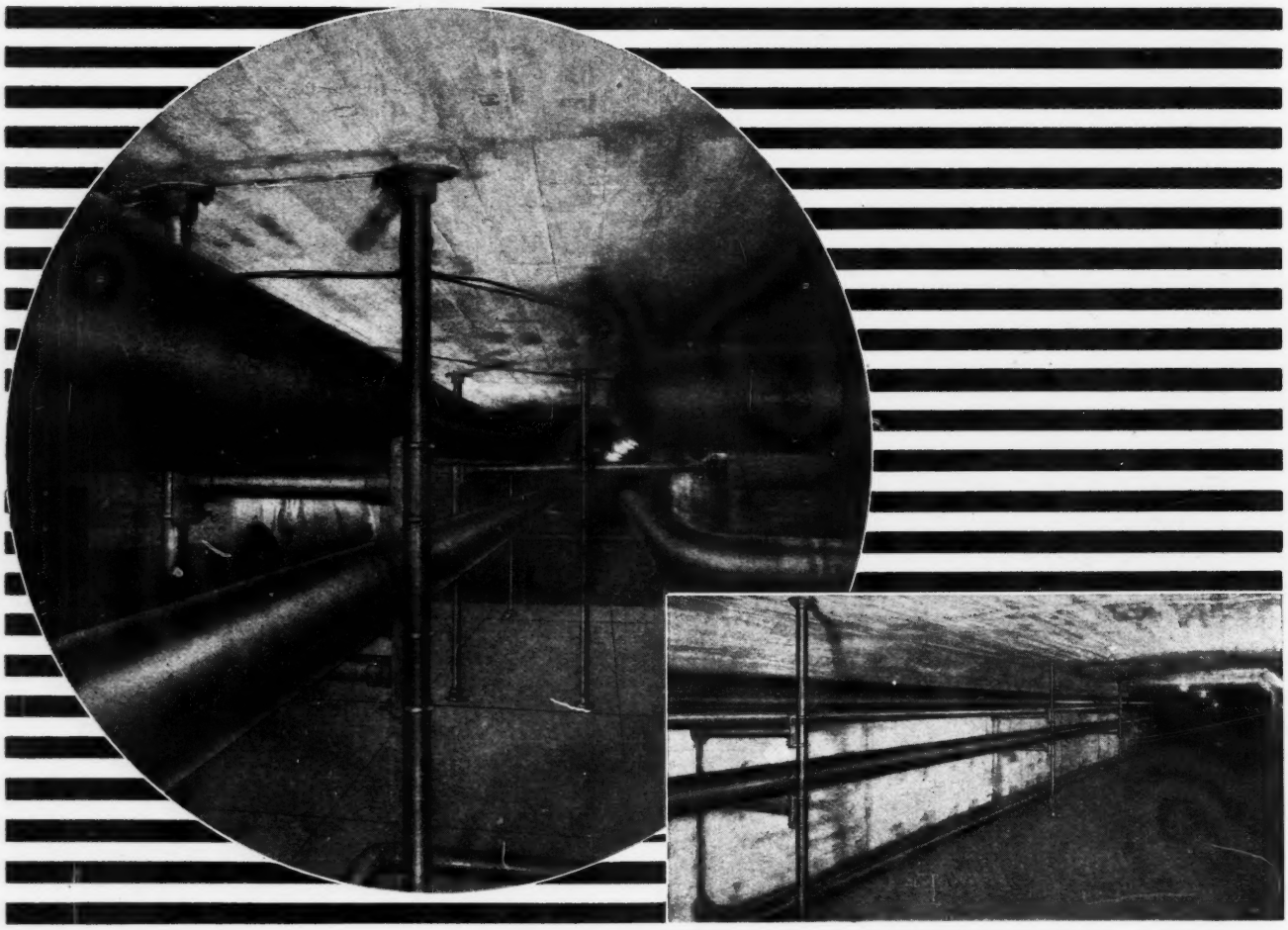
REPUBLIC *ELECTRIC WELD PIPE* SERVES ATTICA PRISON



The major part of the steel pipe used in the steam mains that traverse the tunnels under Attica Prison, Attica, N.Y., is Republic Electric Weld Pipe. Several hundred tons were required, furnished by W. A. Case and Son Mfg. Co., Buffalo, N.Y.

Republic Electric Weld Pipe is ideal for steam installations and particularly those involving long runs.

This unusual pipe has many advantages. Because it is electrically welded, the weld is as strong as the wall. Because it is formed cold, it is perfectly round. Because the metal from which it is rolled is uniform in thickness, the finished pipe is uniform at every point in the wall. It is also free from scale inside and outside, perfectly straight, and available in lengths up to 50 feet.

All these features help to cut down installation costs and make for a clean, safe job that will stand the test of time.

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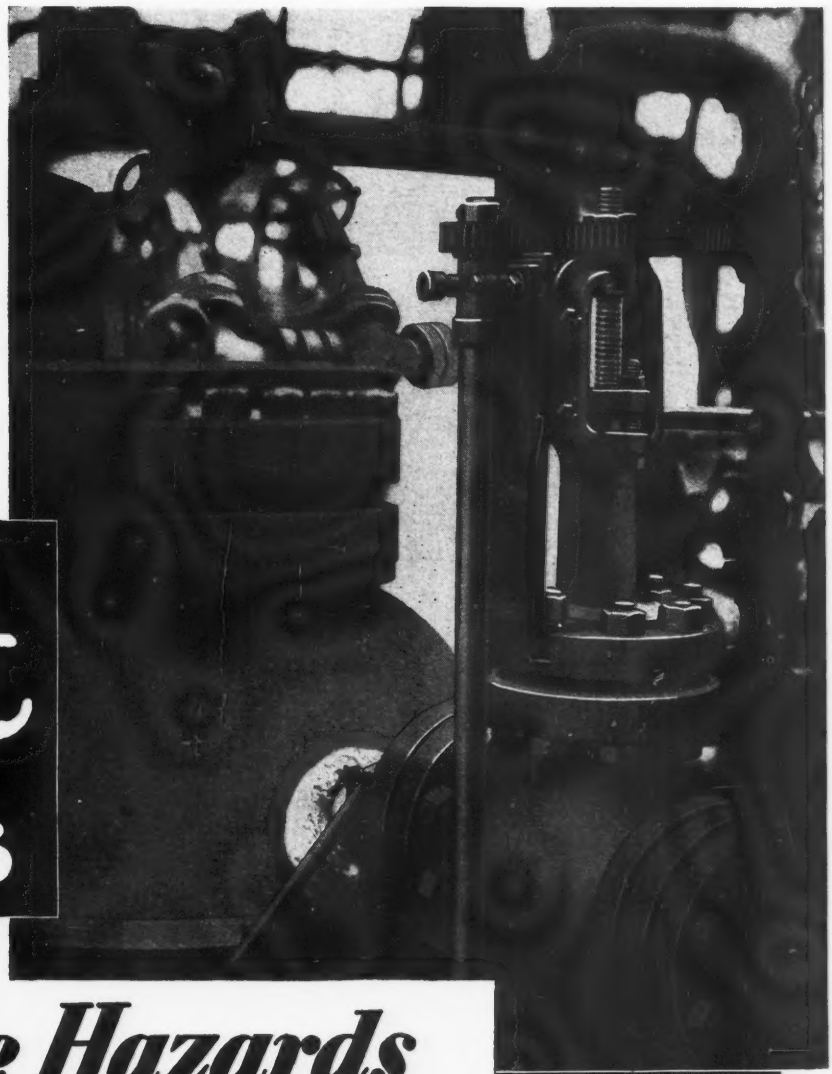

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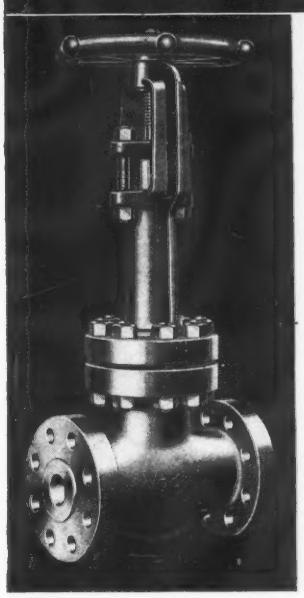

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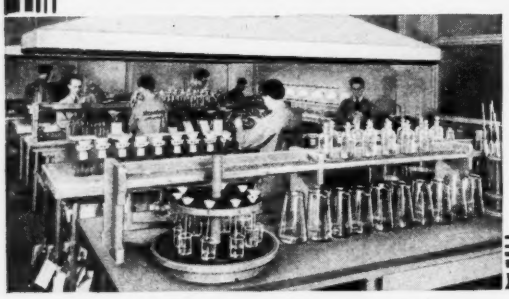

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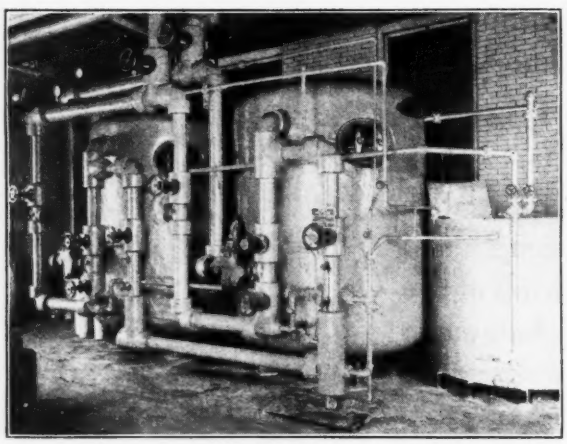

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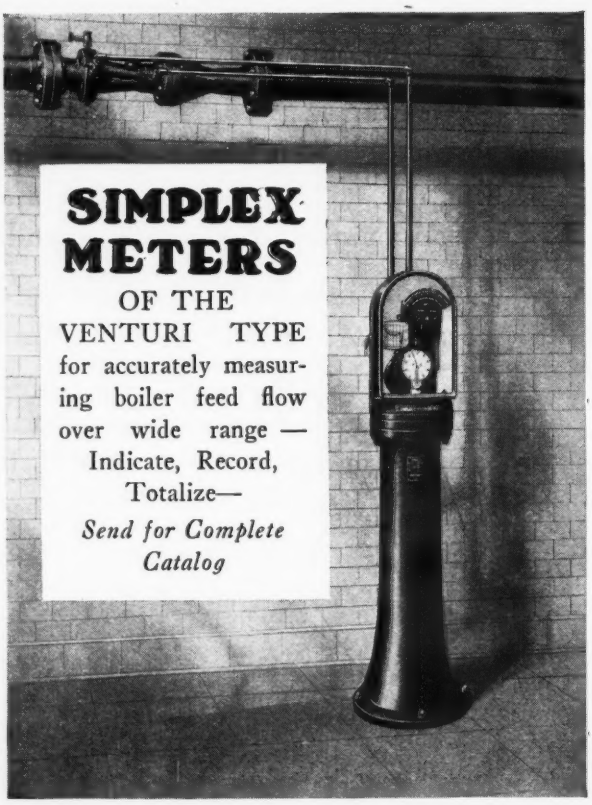

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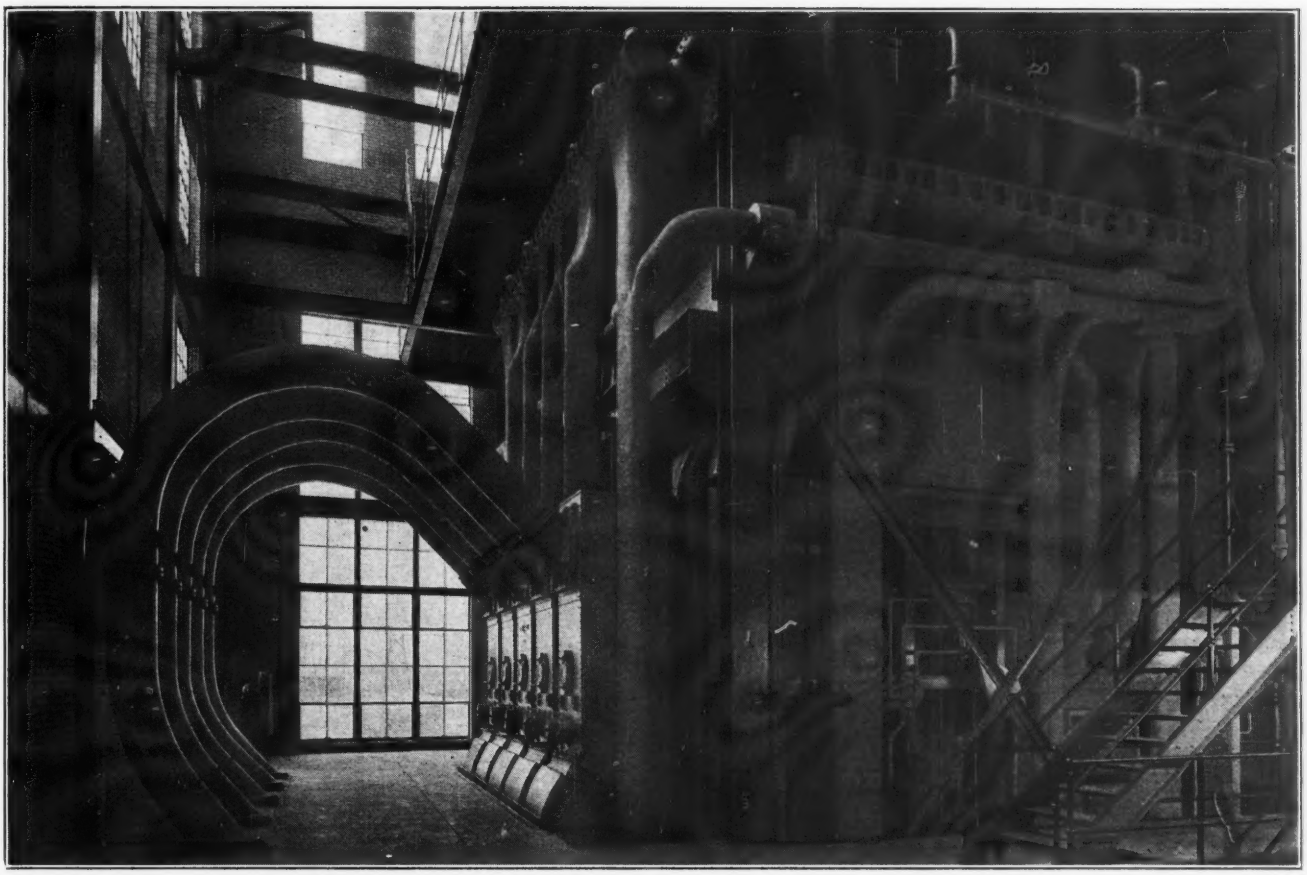

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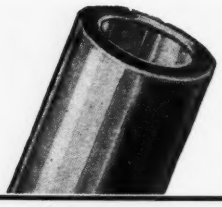

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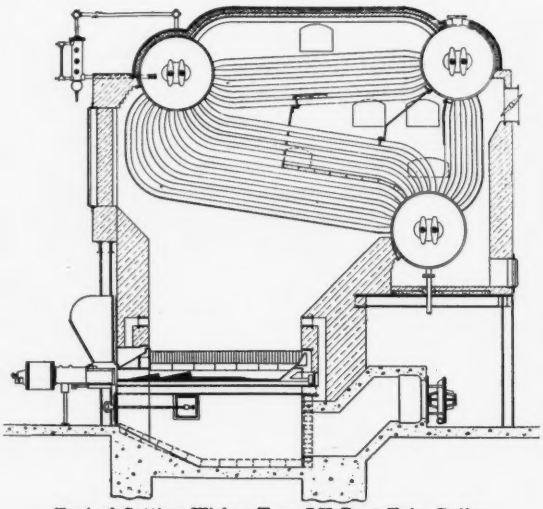

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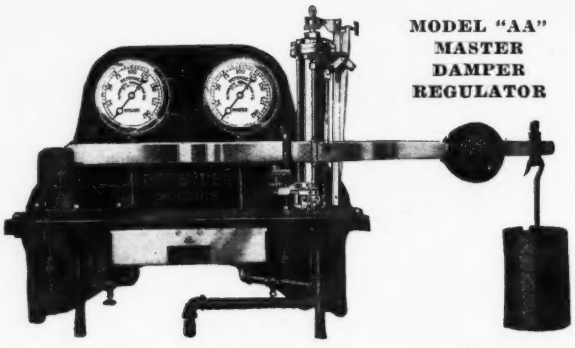

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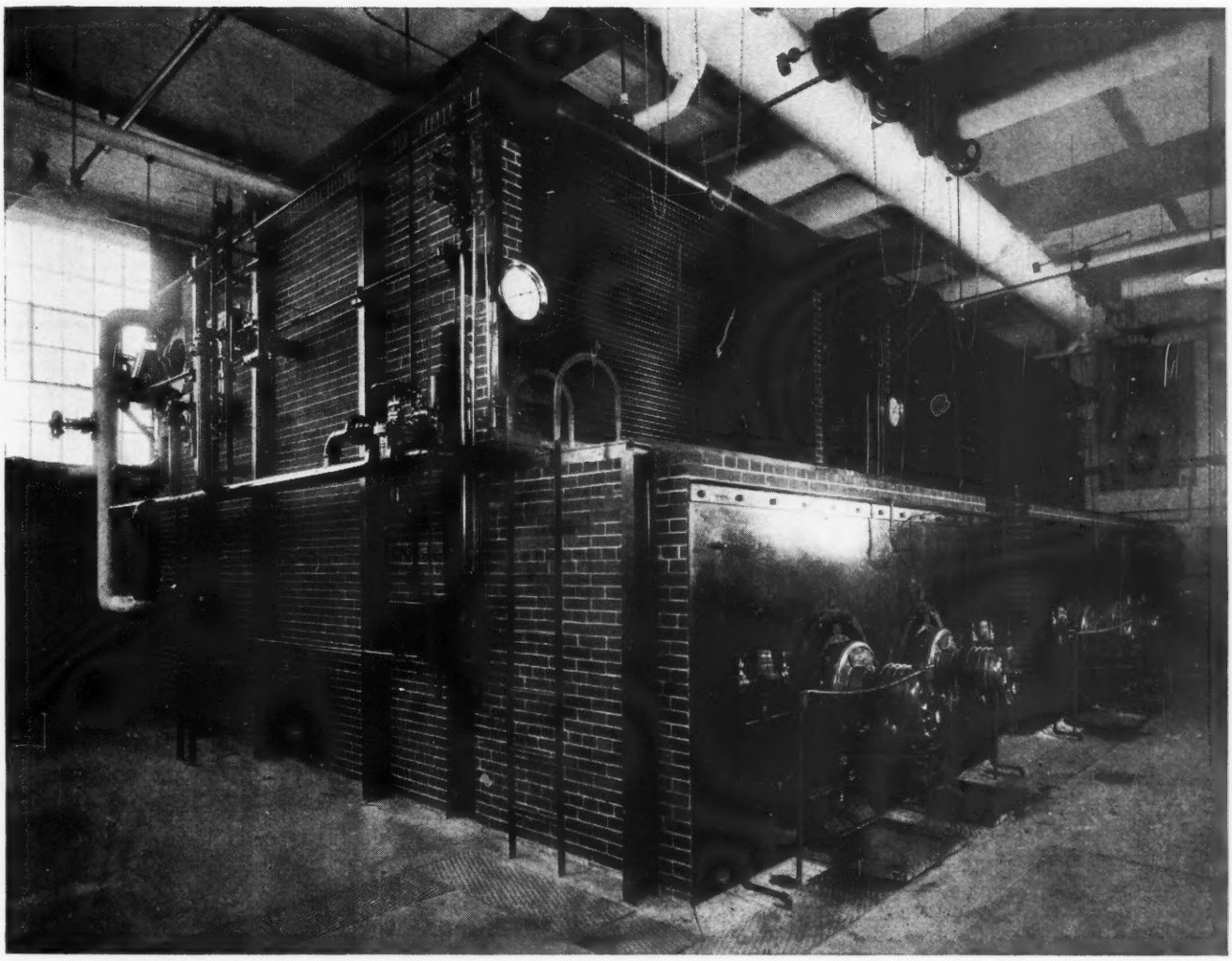

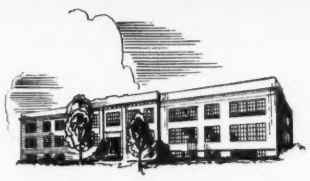

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Public Works are always under public scrutiny. Never have Edge Moor Boilers failed to demonstrate the good judgment of the engineers and public officials who have selected them—no doubt a major reason for an ever-growing appreciation of the dependability of these steam generators.

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Illustrated above is the boiler room of the Lower Merion Township High School at Ardmore, Pa. (Harry J. Eggley, Engineer)—a typical modern installation of Edge Moor heating boilers, particularly well adapted to this type of service. These three cross-drum type units of 311 horse-power each, were built for 160 lbs. operating pressure. They are equipped with May Oil Burners and Diamond "Air Puff" type soot cleaners.

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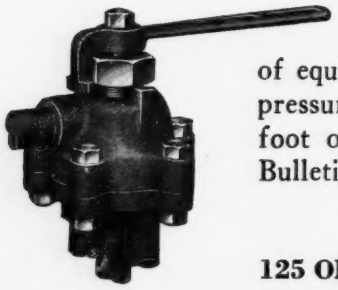

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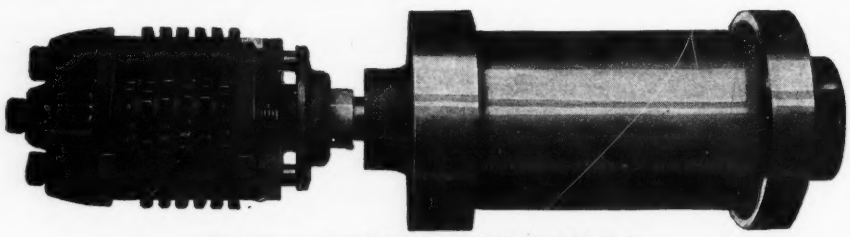

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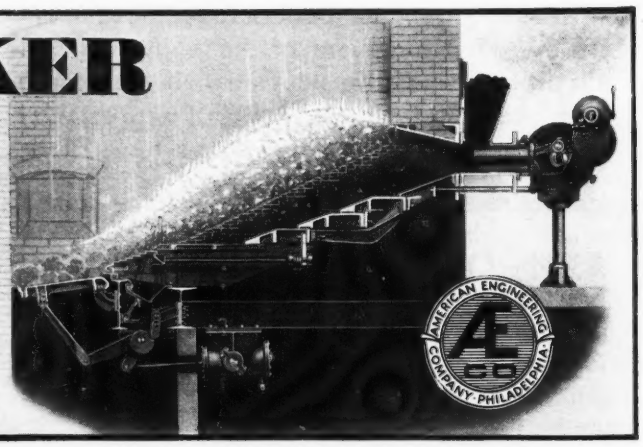

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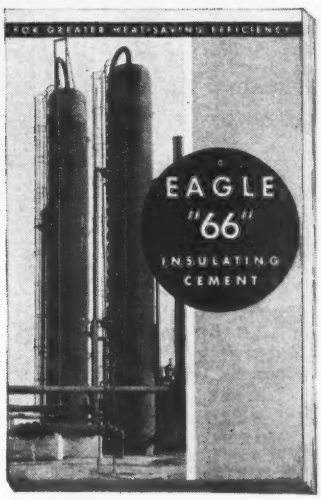

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McNeill REMOTE Water Level Gauge

For users of high set boilers, the McNeill Remote Water Level Gauge is an absolute necessity. It brings the indicator down to the instrument panel where it can be seen clearly and distinctly at all times, permitting safer and more economical boiler operation.

No part of the McNeill Remote Gauge is subject to boiler temperatures, a fact that explains the long life of the gauge and the absence of operating costs.

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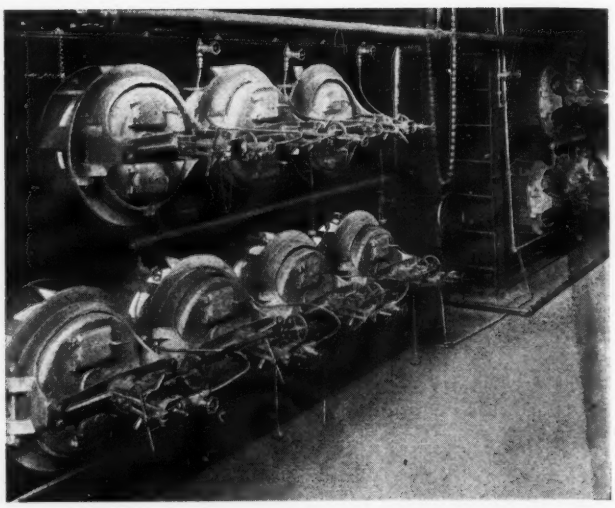
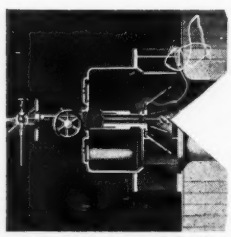


The extent to which the Bethlehem (Dahl) Mechanical Oil Burning System is being used in all types of boiler plants is to a large degree the result of its high efficiency.

In the first place, it is a mechanical system. The oil is atomized by heating and then forcing it under pressure through the burners. Thus, steam that would otherwise be diverted from useful work to atomizing purposes is saved. A second economy feature of the Bethlehem (Dahl) System is the provision for accurate air regulation, enabling the operator to adjust the air to the exact amount required for perfect combustion.

Other important advantages of the Bethlehem (Dahl) System include simple, flexible fire regulation to meet fluctuating loads; the ability to handle any grade of oil, including the heavy, low-cost oils; and adaptability to almost any type of boiler.



Sectional view of Bethlehem (Dahl) Furnace Front. The oil, heated and under pressure, is sprayed into the furnace, perfectly atomized

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BETHLEHEM DAHL mechanical Oil Burning System

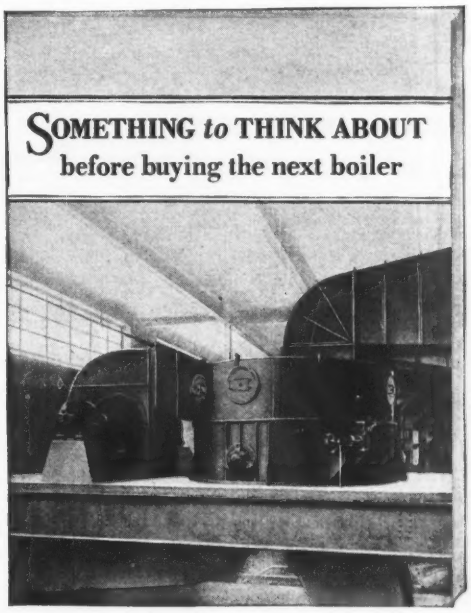
Why buy boiler heating surface that does little and returns almost nothing on the investment!

There's only one logical answer
You'll find it in this booklet →

HEATING surface nearest the furnace generates most of the steam; that nearest the stack ***almost none.*** Yet the sluggish surface costs as much as the intensely active, and at high pressure and temperature operation, makes a big difference in the cost of the boiler.

Eliminating the inefficient last-quarter heating surface and distributing its work over the remaining surface comprising a ***smaller boiler,*** saves practically ***one fourth the cost of the larger boiler and its installation.***

The original steaming capacity of the larger boiler can be obtained in a very practical way from the smaller, by high recovery of stack heat in a Ljungström Air Preheater and utilization of this recovery to preheat the combustion air. The preheat stimulates the heat absorption capacity of the entire heating surface and ***only slightly increases*** the work of each square foot in the smaller boiler to make the ***total delivery equal to that of the larger unit*** fired with cold air.



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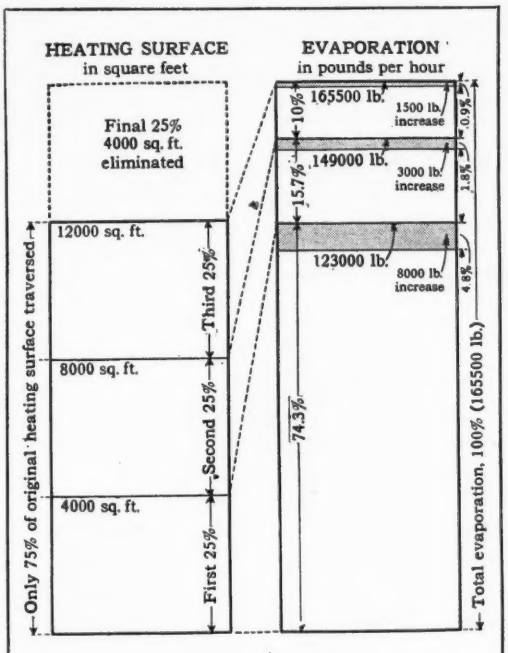

Typical effect of doing away with inefficient last-quarter heating surface in a boiler receiving cold combustion air, where the elimination is made by substituting a smaller boiler utilizing preheated air, to get the same total steaming capacity from only three-quarters as much boiler heating surface.

The small amount of work done in the sluggish fourth quarter of the larger boiler is performed in the smaller boiler by addition to the work of each of the remaining three-quarters as indicated by the shaded areas.

The figures are based upon a 16,000-sq. ft. boiler normally generating 165,500 lb. of steam per hr. from and at 212 deg., when fired with coal, oil or wood and using 70-deg. combustion air. The rating is assumed not to exceed 300 per cent. In such a boiler the active first-quarter heating surface generates about **70 per cent** of the steam, and the last quarter **less than 8 per cent.**

Substituting the smaller boiler, 12,000 sq. ft. of heating surface, with preheated air to do the work of the last 4000 sq. ft. in the 16,000 sq. ft. boiler, increases rating from 300 to approximately 400 per cent, regardless of whether the pressure is 200 lb. or 700 lb. Considering that modern water tube boilers cost between $20.00 and $40.00 per h.p., depending upon working pressure, dispensing with the sluggish final 4000 sq. ft. of heating surface effects a saving of from $8,000.00 to $16,000.00 in a boiler of this size.

Ljungström Preheater capacity to do this costs only about ***half as much*** as the cold-end boiler surface it displaces, and leaves the other half applicable to reduction in initial cost and fixed charges, or available for investment in additional preheater capacity to produce a fuel saving of ***at least 10 per cent.***

The booklet will show you intensely interesting possibilities, and our Engineers are ready to submit convincing figures and proof applicable to your own conditions.

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Ljungström AIR PREHEATER
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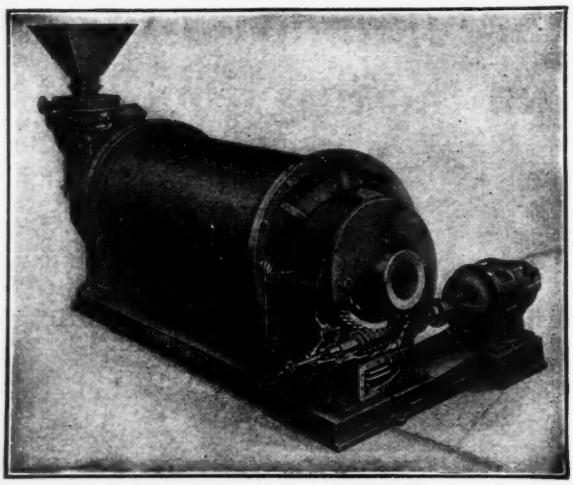
CONTINUOUS REGENERATIVE COUNTERFLOW



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Kennedy Pulverized Fuel System?

The Answer is

Simplicity . . . Reliability . . . Durability

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Low Operating Costs

What is the ratio of your steam cost to that of your finished product? There is a substantial saving possible by the use of the KENNEDY SYSTEM.

The KENNEDY PULVERIZED FUEL SYSTEM excels on all grades of fuel, enabling you to produce steam at a cost far below that obtainable with other systems.

THE PULVERIZER WITH THE TROUBLES LEFT OUT

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If you could save as high as 3% of your coal at a cost of less than 2c. per ton for crushing, including labor, maintenance, operation, depreciation and interest on investment, would it pay you to do it?

Fuel economy begins with an—

American Ring Crusher

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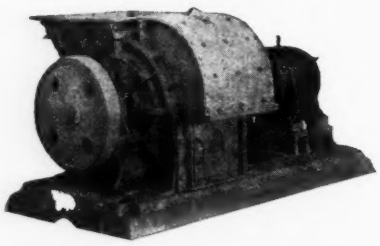

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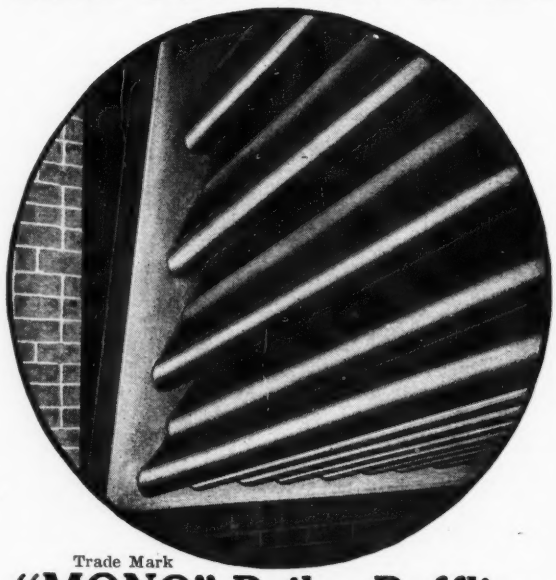

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"MONO" Boiler Baffling

"Hugs the Tubes"

Once built—they are there to stay. Every tube is sealed perfectly against gas leakage—yet it may be drawn when cold and replaced without injury to the baffles. Use the turbine driven vibratory scale cleaner as often as you are now doing. It can't injure "Mono" Baffles. Positively withstands temperatures to 3300 deg. F. *Write us for a bulletin.*

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Let's tear it up!

Let's find out what makes it go!

Just what is this K.W.S. SODIUM ALUMINATE SYSTEM of treating boiler water?

Here's the story in brief –

K.W.S.

SODIUM ALUMINATE

SYSTEM

A TRADEMARK associated for more than ten years with pioneer work in the solution of boiler water problems.

A COAGULANT with valuable properties in completing softening reactions. The experience and facilities of this company for producing suitable sodium aluminate for boiler water use are unapproached.

THE reputation behind the trademark and the success of sodium aluminate in thousands of plants rest squarely on the engineering service rendered as an essential part of the K.W.S. System. There is no substitute for the work of our staff of laboratory and field engineers. Their free service to customers includes preliminary survey, supervision of daily treating by means of report forms furnished by us, periodic checking of conditions in the plant, and special research or counsel whenever unusual or emergency needs arise.

The K.W.S. Sodium Aluminate system is installed only on the basis of demonstrated economies and improvements. You cannot lose by asking for a free survey.

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Specialists in water softening, filtration, process work, waste water disposal, and all problems involving water supply and treatment

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6222 West 66th Place, Clearing Sta., Chicago, Ill.

Have an engineer make a boiler water survey of my plant. This will not obligate me in any way.

Give me the names of nearby users of K.W.S. or customers of yours having plants similar to mine.

Send me your free booket "Standardized Feedwater Treatment"

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P12-15 Gray

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Including Air Conditioning and Cooling and Household Automatic Refrigerating Machines

HERE is a new edition of this well-known guide book, completely revised and enlarged to cover the latest developments in the field. It is a thorough treatment of the theory, operation and testing of modern refrigeration systems for the operating engineer in refrigeration plants, and the man engaged in servicing and installing household refrigeration equipment.

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538 pages, 6 x 9
291 illustrations,
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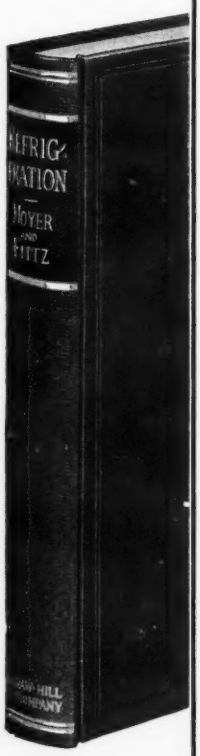

The book tells you:

What the various refrigeration systems and methods are—how they differ from each other—how they work—how they are kept in working condition.

What the properties of refrigerants are—how ice is made by different systems—how cold storage compartments and buildings are made—best methods for storing foods.

All in all the book is a complete guide for anyone who wants a thorough understanding of the principles of mechanical refrigeration, how they are applied in different types of equipment, how this equipment should be installed, operated, tested, etc.

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P. 12-32

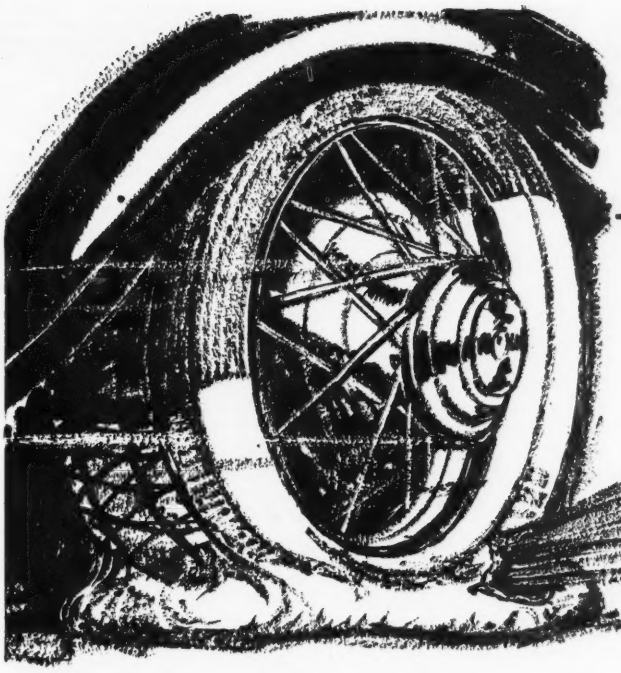
"A raise!"

"MORE money in the old envelope and, believe me, I can use it. Something I said to the boss brought me this raise. I told him what we needed in this building was Otis Elevator Maintenance.

"He said we had very little trouble with elevators and didn't know whether or not the building could afford Otis Maintenance. (It isn't more costly, he just imagined it was.) I told him we ought never to have elevator trouble and I urged him to just try Otis Maintenance. Believe me, it made a real difference in the elevator service! There's mighty few empty rooms in this building today."

Your building owner or manager will welcome anything which will add prestige to the building. He'll really appreciate your telling him about Otis Elevator Maintenance. It's just such little things like this that help to make your pay envelope fatter.

We want to acquaint you with all the details about Otis Elevator Maintenance and how it can be of help to you. Won't you just call the Otis office in your city and ask them about it? They'll be glad to give you complete information. Otis Elevator Company . . . 339 offices throughout the world.



Get the AIR-REMOVAL CAPACITY of a "Blowout" with a new

ARMSTRONG TRAP

thermic vent

THE exclusive Armstrong development shown at the right below will vent air many times as fast as the ordinary steam trap. Almost any desired air removal capacity can be provided.

The standard Armstrong Trap vents air automatically as shown at the lower left and for most types of service this arrangement is entirely satisfactory. The thermic vent is added when submerged coils, unit heaters, jacketed kettles, hospital sterilizers, greenhouse radiation, steam heated cylinders in paper or textile mills, or other similar installations require the extremely rapid elimination of a very large volume of air.

If you have a problem in venting air take it up with the Armstrong representative or write us. The new Armstrong thermic vent offers a standard of service on such jobs never before available.

ARMSTRONG MACHINE WORKS

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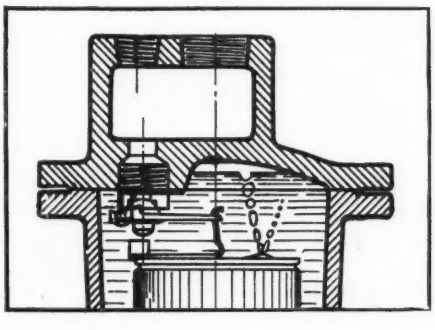
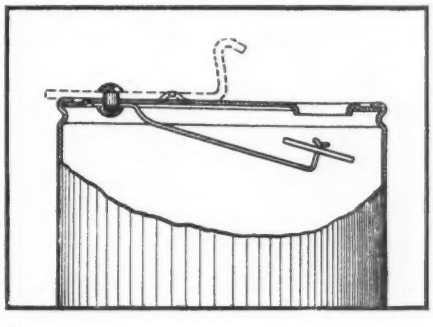
P 12-Gray

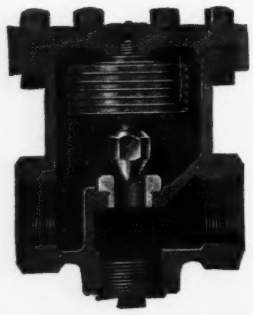


AT LEFT: The air vent in the top of the inverted bucket in an Armstrong Trap prevents air binding. Any steam that passes through the small standard vent is condensed to make up for radiation loss from the trap.

AT RIGHT: The large vent is closed by a flat disc fastened to the end of a strip of thermic metal. When the trap is cold the vent is open as shown allowing air to pass through so rapidly that the bucket cannot float and the discharge orifice therefore cannot be closed. As the temperature in the bucket rises, the bending of the thermic strip closes the vent and the trap functions in the normal manner.



NICHOLSON
INDUSTRIAL STEAM TRAPS



▲ A rugged heavy duty bellows trap for draining unit heaters, coils, dryers as well as all classes of equipment where process steam is used. Sent on trial.

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Type HS Horizontal MOTOREDUCER

The MOTOREDUCER catalog gives complete information regarding the units,— write for a copy.

Better— tho MOTOREDUCER -the MOTOREDUCER

The MOTOREDUCER is a "built-in" unit, — a single housing contains the motor and speed reducer. It is extremely compact, affording a great saving in space, and requiring no flexible couplings or base plate. The unit has high operating efficiency and requires a very minimum of maintenance cost.

The MOTOREDUCER is furnished in either horizontal or vertical types, in single, double or triple reductions. Ratios up to 450:1. Standard open type or totally enclosed fan cooled motors, single phase or polyphase, are available. Also direct current motors up to 10 hp.

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Industrial Gears and Speed Reducers

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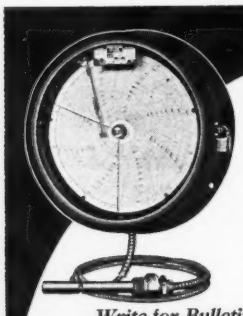

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For feed-water, flue gas, super-heated steam and economizer temperatures. Also for every process temperature in ranges—60° F. to 1200° F. guaranteed accuracy—long life—and low cost. Multiple-pen Recorders up to 4 pens on one chart. May be combined with Recording Gauges.

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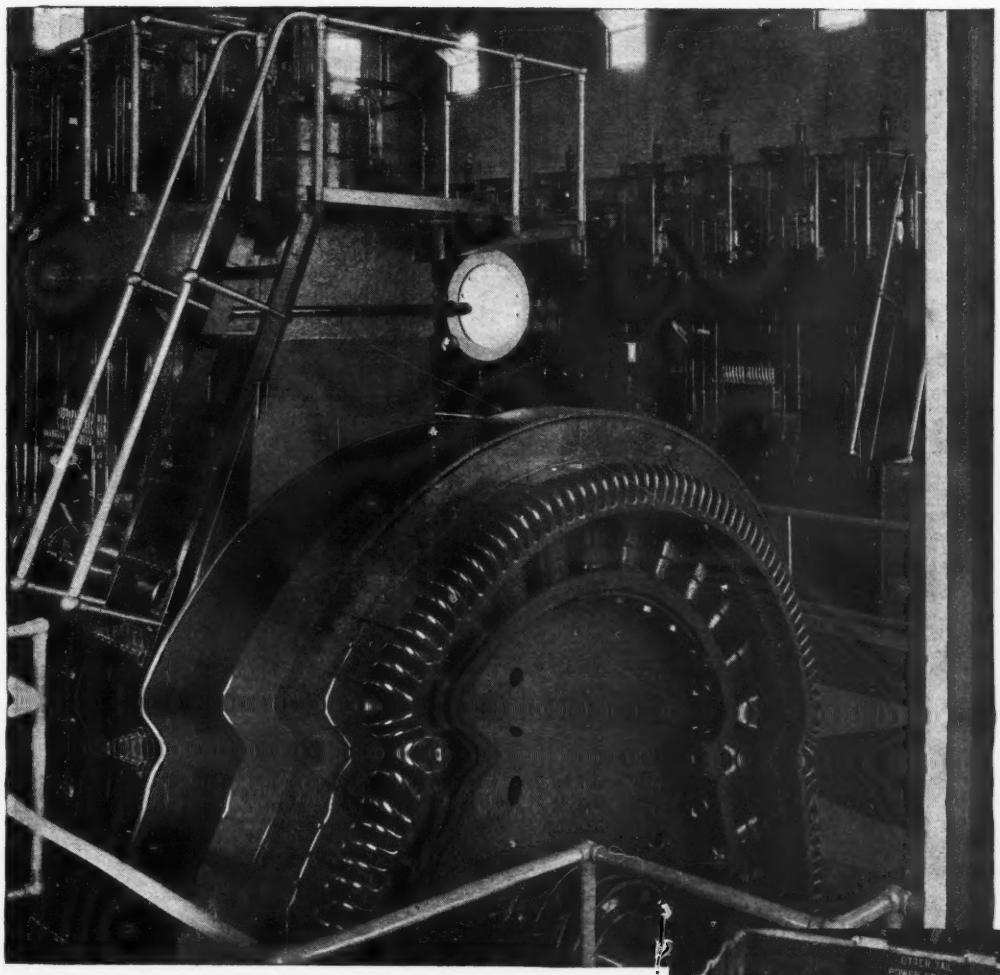

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The Appleton, Minnesota, plant of the Otter Tail Power Company, completed in 1930, is a notable example of the modern Diesel installation. It is designed for peak load and standby service, operating 16 hours per day. In keeping with the high type of equipment and operating efficiency, Texaco Lubricants were selected for the responsible task of maintaining maximum power output at the lowest possible cost. • The plant has been lubricated by Texaco exclusively since starting up. Guarantees on fuel economy and lubrication requirements have been continually exceeded. • There are two eight-cylinder, 1760 h.p. Nordberg Diesel engines operating at 275 r.p.m., direct connected to two 1500 K.V. A. alternators. The engines are of the two-cycle, crosshead type with air injection. • Texaco Algol Oil is used for bearing lubrication and piston cooling. Texaco Ursa Oil lubricates the power cylinders and Texaco Ursa Oil C lubricates the compressor and scavenger pump. • Chief Engineer G. W. Welch is highly satisfied with the effective work of Texaco Lubricants at this plant. Texaco Lubricants and Texaco engineers combine in offering an unsurpassed lubrication service.

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Always Properly Filled ~Never to Overflowing

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FULTON Altitude GOVERNOR

THE Fulton Tank or Altitude Governor is designed for installation on a single line to an elevated tank, permitting full flow upward so long as the storage water is below a fixed level, permitting full flow downward in any emergency, but ordinarily and in normal use keeping inlet and outlet alike under control. Water will flow in either direction through the valve, according to whether pump pressure or tank pressure is greater at the moment. Thus the proper level is maintained, in the interest of economy and safety. Ask for a descriptive circular.

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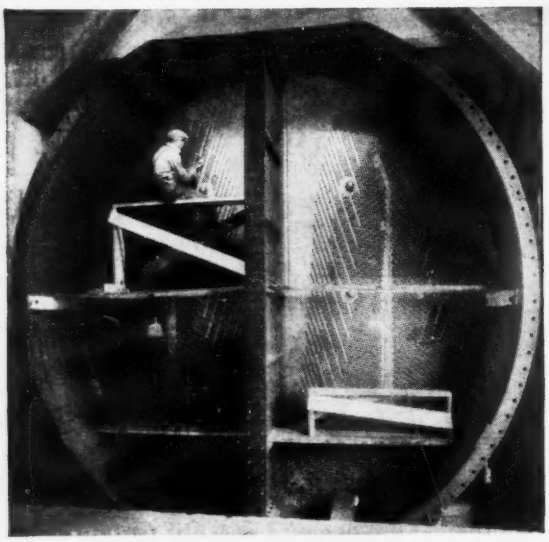

Over 50 installations for Ford

These installations throughout Ford Motor Company plants are genuine tribute to the efficiency of this packing.

FORD HAS CUT Condenser Maintenance

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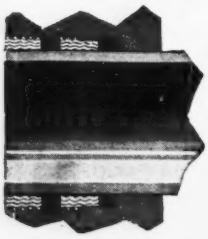
METALLIC TUBE PACKING

The "John Crane" process of packing condenser tubes will help you in cutting maintenance expense and raising power plant efficiency, as it has helped Ford Motor Company and a long list of other industrial and Public Utility Companies.

FERRULES ELIMINATED

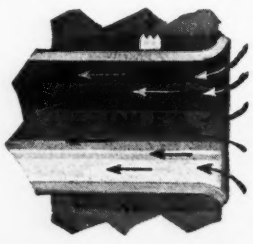
Saving ferrule costs. Reducing installation costs. This packing is by far the most rapidly installed.

Tubes remain tight and condensers operate as distillers.



Outlet end metallic packed. Perfect seal. Reduced friction. Tubes free to move. No split or crushed tubes.

Inlet end belled and fixed. Perfect bonding. No electrolysis. Flush tube sheet. Improved flow.



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Bell the Inflow - Pack the Outflow - by the "John Crane" Method

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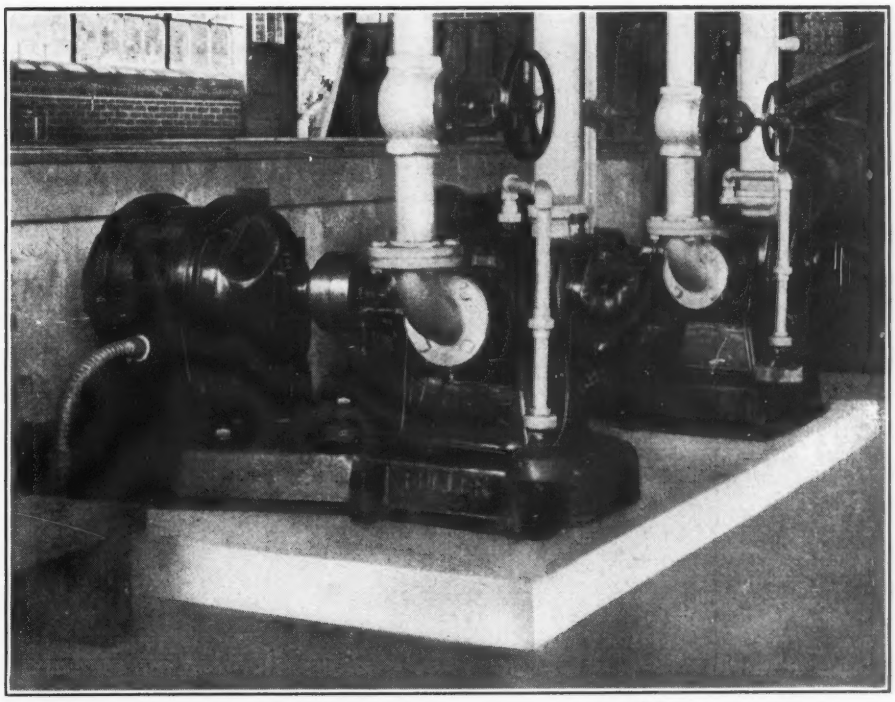
of simple design for continuous service



Two Type C-24, single-stage, Fuller Rotary Compressors. Since their installation about a year ago, these units have been on continuous 24 hour service, without shut-down for repair or adjustment. Contrast the compact simplicity of this installation with conventional compressors.

Write for a copy of Bulletin C-3, for complete information on the operating and design features of these unique machines.

One of the conspicuous features of Fuller Rotary Compressors and Vacuum Pumps, which set them apart from all other types, is their unique mechanical simplicity. Their design is free from the usual complicated working parts, requiring frequent adjustment and replacement. There are no valves or reciprocating motions.

The compressors are available in a full range of capacities, for working pressures up to 125 pounds. They are of a novel rotary, multi-blade type, designed to be directly driven at common motor speeds. All working parts are totally enclosed. This simplicity of design adapts them for long service under full load conditions.

Their vibrationless operation and compact arrangement adapt them for convenient and cost-saving installations at the point of air consumption.

Vacuum Pumps of the same type are furnished for vacuums up to 29.75″.

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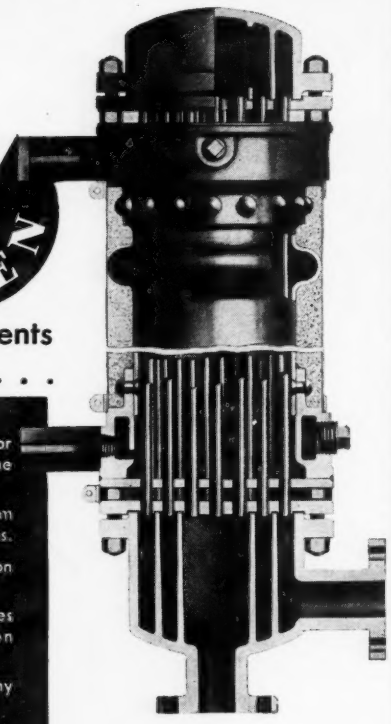

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Outside joints permit oil or steam leaks to drain to the atmosphere.

Progressive heating from center to outer row of tubes.

Built with integral expansion joint.

Tube arrangement reduces oil pressure drop between passes.

Heater may be used in any position.

Reversal of oil flow and circulation of cold water turns the Coen Oil Heater into an oil cooler.

Removal of one head permits inspection of tubes without breaking pipe connections.

. . the new Outside Joint Oil Heater

With the new Coen Oil Heater it is impossible for oil to enter the steam space and find its way into the boiler, hot well or cooling tower through leaky tube joints. The outside joint construction of the heater makes this all-important feature possible. Designed by experienced engineers and fabricated from the highest quality of materials, the Coen Oil Heater has successfully met every stationary and marine inspection.

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The Coen Oil Heater is a finished product in every way. Castings are of steel, the heater shell is covered with insulating material protected by metal cover and secured by chromium-plated bands. Center space of the double tube sheets is likewise covered with a band easily removed for inspection.

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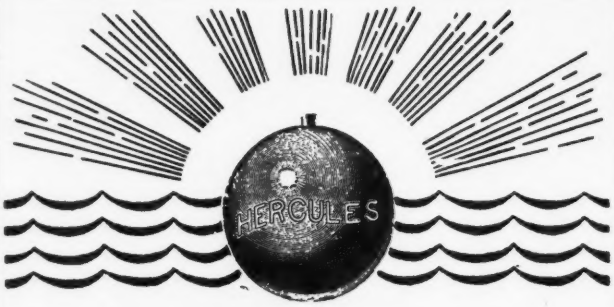

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Not when HERCULES Seamless Copper Floats are used to maintain the water level in heaters, tanks, reservoirs and other appliances.

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Ready to ship—all ball shaped sizes to 10 in. inclusive. Special shapes or sizes furnished promptly on order.

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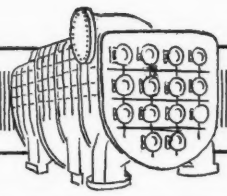

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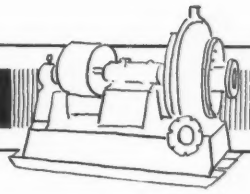
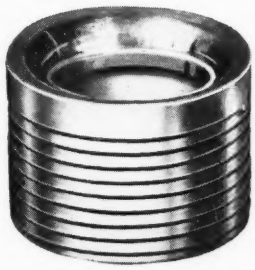


NEW *SLOTLESS* CONDENSER FERRULE



No explanation is required to show the trained Engineer the value of the new

SLOTLESS FERRULE

Eliminates general water flow disturbance—Same price as ordinary Ferrule.

Condenser Service & Engineering Co.

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Branches: Boston, Cleveland, Philadelphia, New Orleans, Baltimore, Atlanta, Pittsburgh

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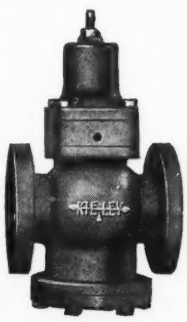

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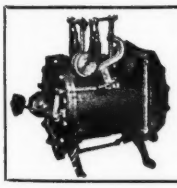

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Rolling-weight action opens and closes valves so quickly that wire-drawing is delayed.

Return, Lifting, Vacuum and Separating Traps

all operating on same principle. Write for details.

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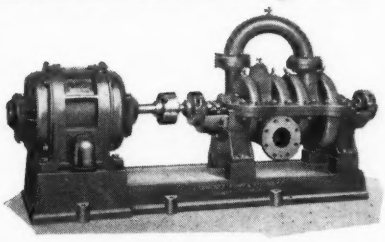
Modernize your pumping service

with High Efficiency



Lawrence "Vortex" Pumps

Every pump in the Lawrence line has been developed for high efficiency pumping service. Substantial savings in operating costs are assured through lower power consumption.

These pumps are recognized in power plant and other industrial services for outstanding performance and quiet, smooth, carefree operation.

The complete Lawrence line includes pumps for various types of Service. Write for details.

Lawrence Pump & Engine Co., Box 70, Lawrence, Mass.

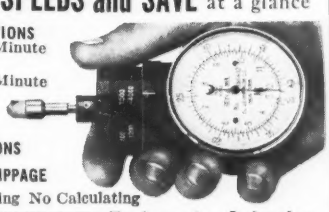
TEST SPEEDS and SAVE at a glance

REVOLUTIONS Per Minute

FEET Per Minute

SPEED VARIATIONS

BELT SLIPPAGE

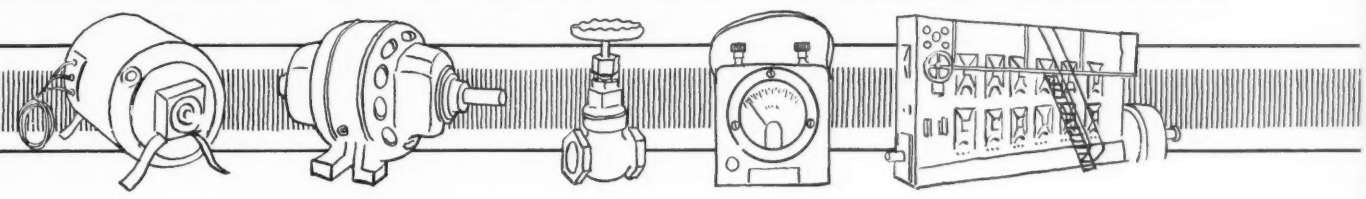


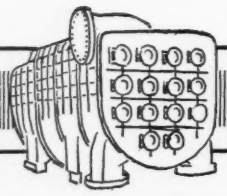
No Timing No Calculating

O-Z Improved Hand Tachometer-Cutmeter

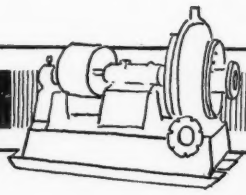
Single Spindle—Selective Range for Speeds from 20-40000 R.P.M. 10-20000 F.P.M. **Rotating Gear Shift** eliminates all shifting troubles. **Ball Bearing** (no more frozen spindles). **Over All Length** reduced ¼. **Dead Beat, Dust Proof. Rugged, Fool Proof. Accurate** within ½ of 1%.

O. ZERNICKOW CO., 21 PARK ROW, NEW YORK





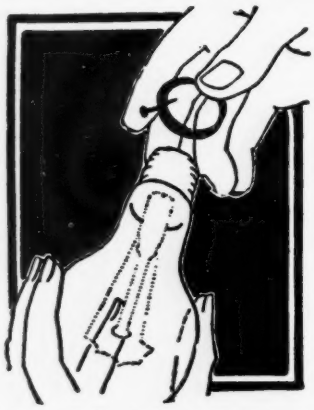
POWER SERVICE SECTION



«« AT LAST »»

NO MORE

STOLEN BULBS



No more bulb theft. Easy to attach. Only special tool furnished will permit bulb removal. Bulbs removed without breaking glass. Write for prices and trial order form.

AMERICAN INDUSTRIAL CORP.
New York Central Bldg., N. Y. C.

WIND VELOCITY, SUN EFFECT, OUTDOOR TEMPERATURE,

COMBINED IN THEIR RELATIVE PROPORTIONS into a Master Control to provide proper pressure in the steam mains for all weather conditions.

SUPERSTAT MODULATING CONTROL provides 12 valve positions based on the three BASIC WEATHER ELEMENTS.

SUPERSTAT COMPANY, SPRINGFIELD, MASS.

Keep Your Equipment FREE FROM DIRT with this

CLEMENTS BLOWER

Cut down your fire risk and avoid danger of "shorts" and "burn-outs" in your electrical equipment. Clean out the dust and dirt from your motors, generators and converters with a stream of clean dry air at high velocity. The Clements Blower is instantly convertible for suction cleaning stock bins, etc. Attach to any light socket. Made in four models.

WRITE TODAY for details of our 10 DAY FREE TRIAL OFFER

CLEMENTS MFG. CO., 6650 So. Narragansett Ave., **CHICAGO**

SMOKOMETER AND All Types Smoke Indicators.

Shadow screen and light-sensitive cell devices, Simplex, Smokgage, Smokelite, Smokbell and special circuits.

ESS INSTRUMENT CO.
816 Agnes St., Parkersburg, W. Va.
N. Y. Rep., 30 Church St.

M·A·N

MASCHINENFABRIK AUGSBURG-NÜRNBERG A·G·

DIESEL ENGINES

from 40 to 1500 Hp. from stock. Sales Agents Wanted.

New York **F. J. JOERGER** 40 Rector St.

For dependable service use

DURA-STIX
FIREBRICK CEMENT

Send for our new booklet K-30.

KEYSTONE REFRACTORIES CO.
120 Liberty St., New York

FOR WATER SOFTENING, USE

ZECO GREENSAND ZEOLITE

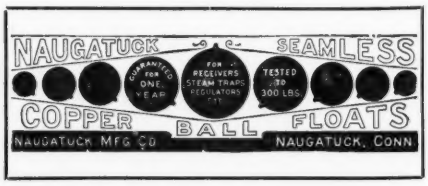
It produces zero-soft water. Its capacity is constant, and it lasts indefinitely: It is not injured by hot water, or by slightly acid or alkaline waters, or by waters containing iron, sulphides, or sediment. Write for pamphlet *Scientific Feed-water Conditioning.*

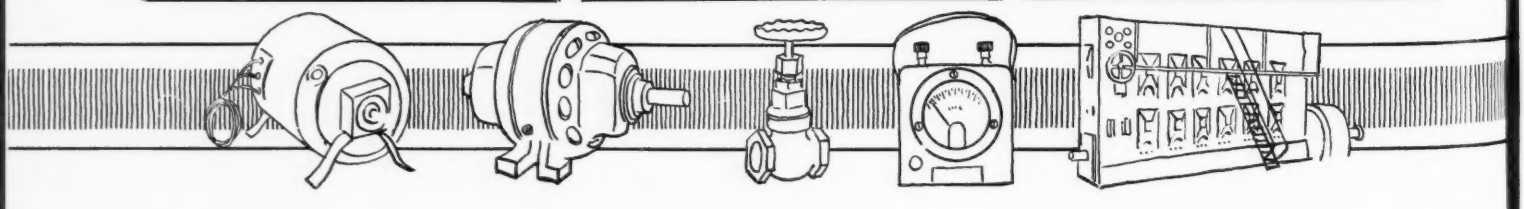
ZEOLITE CHEMICAL COMPANY
140 Cedar Street, New York

KERLOW

Gratings and Safety Steps. Bridge and Highway Decking and Armoring.
Write for Catalogue.

KERLOW STEEL FLOORING CO.
228 Culver Ave., Jersey City, N. J.





LET'S FACE THE FACTS

● Lay-Set Preformed Wire Rope has been sold *on merit* of performance . . . necessarily so, because it is in a different price field than ordinary non-preformed rope.

Merit of performance is proved . . . certainly no building manager, superintendent or engineer would continue to specify "LAY-SET Preformed" for elevator cables unless the service rendered was commensurate with their cost.

So here was the incentive to keep accurate records of Lay-Set performance . . . and as a result of these records of performance, Lay-Set Preformed Wire Rope sales have steadily grown in volume.

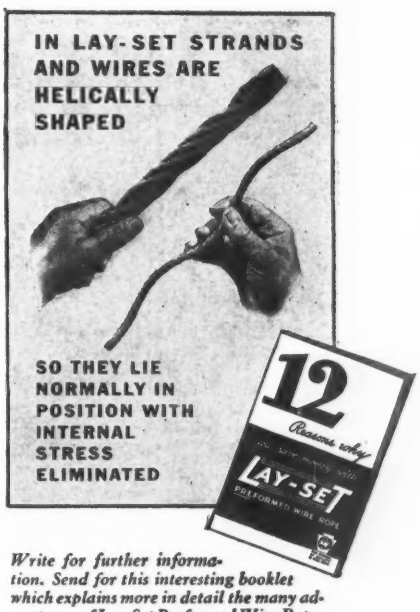
INTERNAL STRESS IN WIRE ROPE IS COSTLY . . . AND INEXCUSABLE

● How can 114 separate wires work in unison and resist fatigue in *non*-preformed wire rope—when each wire is under coil spring tension?

How can the strands of *non*-preformed wire rope carry balanced loads when the structure is unbalanced by this internal stress? Internal stress in *non*-preformed wire rope is a basic fault that is inexcusable.

Preforming strands and wires to their exact helical shapes eliminates internal stress. In LAY-SET Preformed Wire Rope, strands and wires lie naturally and fit perfectly in position. In work, every wire and strand carries its share of the load and does its share of the work—in teamwork with every other wire and strand.

That is why LAY-SET Preformed Elevator Cables outwear ordinary cables by a wide margin. LAY-SET is more flexible and therefore hugs close to the drum groove, resists slippage—and due to elimination of internal stress, LAY-SET does not turn or twist in the drum groove. Face these facts when you are ready for a re-cabling job . . . and specify "LAY-SET Preformed" for elevator and governor cables.


IN LAY-SET STRANDS AND WIRES ARE HELICALLY SHAPED
SO THEY LIE NORMALLY IN POSITION WITH INTERNAL STRESS ELIMINATED
12
Reasons why
LAY-SET

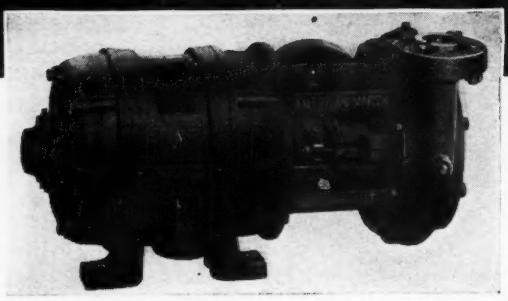
Write for further information. Send for this interesting booklet which explains more in detail the many advantages of Lay-Set Preformed Wire Rope.

HAZARD WIRE ROPE COMPANY

WILKES-BARRE, PENNSYLVANIA

New York Pittsburgh Chicago Denver Fort Worth Los Angeles
San Francisco Birmingham Philadelphia Tacoma

SIMPLICITY and LOW COST



THE shrewd buyer finds this centrifugal pump the logical answer to practically any small pumping requirement. First cost is less; installation is easy; and maintenance almost a negligible factor. The design is simple as A-B-C. That's what saves the money. Note that the pump is bolted directly to the motor, eliminating coupling, pump bearings and base —assuring permanent alignment.

All internal parts may be removed and replaced without disturbing the piping. Discharge and suction connections may be turned for different directions as desired. The one stuffing box is extra deep—easy to get at —easily repacked. A water slinger prevents leakage into motor bearings. No pump foundation is necessary.

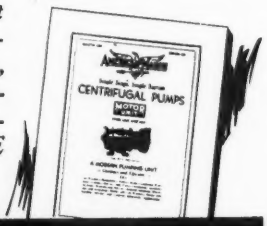
For jobs within its capacity and pressure range, the American-Marsh Motor Unit merits your investigation. AMERICAN STEAM PUMP CO., Battle Creek, Michigan.

FEATURES

1. Compact, efficient and inexpensive.
2. Five sizes with capacities from 5 to 450 G.P.M. at heads up to 120 feet.
3. Bolted directly to 1750 or 3500 R.P.M. motor.
4. No lubrication other than usual motor lubrication required.

WRITE FOR BULLETIN

Bulletin shown at right gives complete information, specifications, ratings, etc. Your inquiry for FREE copy is invited.



AMERICAN-MARSH MOTOR UNIT Centrifugal Pump

SPECIALIZING IN

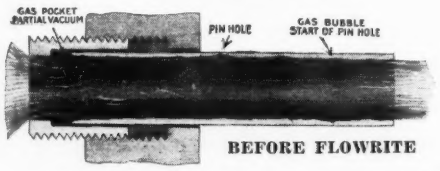
Automatic Priming and Control of Centrifugal Pumps

BARRETT, HAENTJENS & CO.
Hazleton, Pa.

SAVE CONDENSER TUBE RENEWALS

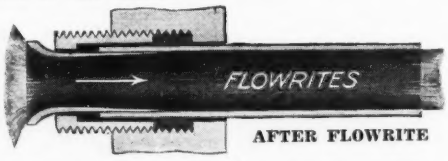
USE "FLOWRITES"

The wearing strip that protects the tubes



BEFORE FLOWRITE

—illustrated above, see how the pocket at the end of the condenser tube collects gas, resulting in constant corrosive action, and pin holes that quickly ruin the whole tube end.



AFTER FLOWRITE

—condenser tube end has no pockets where corrosion can start. Flow is smoothly directed so less power is required, erosion eliminated and pin holes ended. Note that the wear takes place at the end of the "Flowrites" and they may be easily removed and new ones installed, thereby protecting the tubes.

We handle a plug—CONCO—which cleans tubes when FLOWRITES are installed.

Write for bulletin and list of users.

Condenser Service & Engineering Corp.
310 12TH ST., HOBOKEN, N. J.

Branches in BOSTON, MASS.; PHILADELPHIA, PA.; PITTSBURGH, PA.; BALTIMORE, MD.; CLEVELAND, OHIO; NEW ORLEANS, LA.; ATLANTA, GA.

IN

2 YEARS

OR LESS

Management stipulates the requirement "Pay for itself in 2 years" when considering the purchase of production machines and tools.

Pumps are production tools. Warren centrifugals have replaced obsolete equipment and inefficient methods in many plants, paid for themselves in 2 years or less.

For example: An eastern mill replaced a pump handling solid matter in suspension with a Warren pump built for the same purpose, saved $2,500 a year. Another mill operated several hydraulic elevators, each run by its own pump. The small pumps were pulled out and a large Warren centrifugal (with dual drive) installed to feed all elevators. A monthly saving of $250 resulted.

Still another plant took out a pump supplying a certain process and put in a Warren centrifugal. The mill's capacity increased 10-20%, paid for the pump in two months.

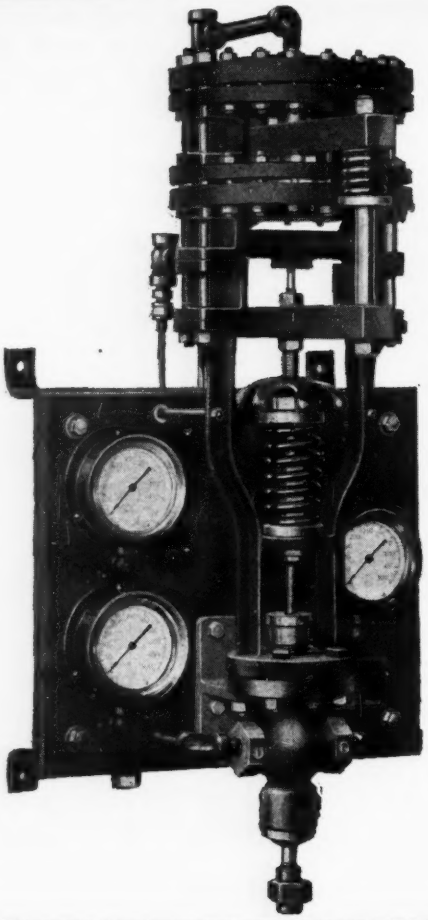
A check of your old pumping equipment may reveal opportunity to lower costs. A Warren engineer will be glad to work with you. Bulletin and estimates sent without obligation.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INCORPORATED

WARREN, MASSACHUSETTS

632



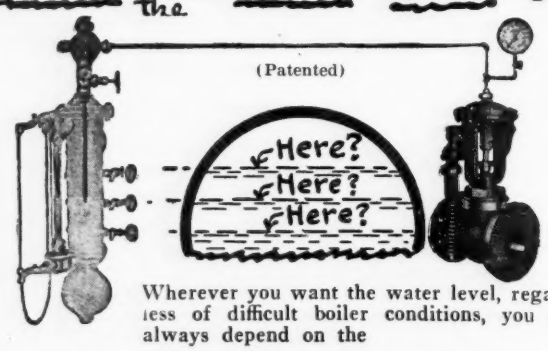
Swartwout
Power Plant Equipment

Every piece of Swartwout Power Plant Equipment is backed by practical engineering experience, which is your guarantee of satisfaction. The list below indicates the broad field covered by this line of apparatus, which ranges from the universally accepted Swartwout Cast Iron Exhaust Head to the new Type "CPDM" Differential Pressure Master Control pictured at the left.

Feed Water Regulators
Differential Valves
Pump Governors
Desuperheaters
Desuperheater Governors
Pump Control
Master Controls
Reducing Valves
Vacuum Governors
Relief Valves
Drainage Controls
Steam Traps
Separators
Exhaust Heads
Water Level Control
Feed Water Heaters
Rotary Ball Bearing Ventilators

THE SWARTWOUT COMPANY
18501 EUCLID AVE. CLEVELAND, OHIO

Where do you want the Water Level ?



Wherever you want the water level, regardless of difficult boiler conditions, you can always depend on the

CAMPBELL
Boiler Feed Water Regulator

Try the CAMPBELL on the worst boiler you can find. You'll be convinced. In the water column shown above the lower end of the supply pipe is level with the middle cock. That, then, is exactly where the level will be held. The position of the end of the supply pipe determines the water level. There's no question about it. Very simple. Absolutely dependable. No moving parts in the control element. No floats. No thermostats. No generators. Nothing to get out of order. No fine adjustments. Any mechanic can install it. No "servicing" necessary.

Get all the facts. We positively guarantee satisfaction. Write for bulletin.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
289 South St., Newark, N. J.

☐ Please send complete information on the Campbell Regulator. Also, please send information on the following Atlas products without obligating us in any way—

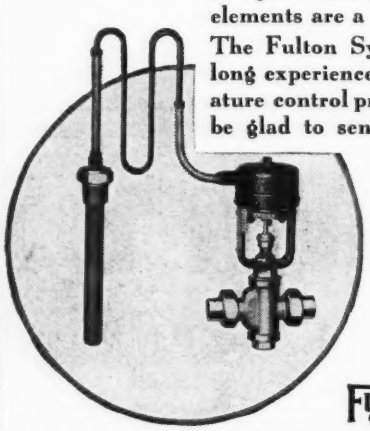
☐ Damper Regulators ☐ Pump Governors ☐ Thermostats
☐ Reducing Valves ☐ Temperature Regulators ☐ Balanced Valves
☐ Exhaust Control System ☐ Swing Joint Fittings ☐ Control Valves
☐ Bronze Unions

UNIFORM PROFITS LIKE UNIFORM QUALITY . . . *depend on* TEMPERATURE CONTROL

FULTON Sylphon FOR TEMPERATURE CONTROL

Under present conditions many manufacturers in many industries are learning the necessary part temperature control plays in producing better products at lower cost.

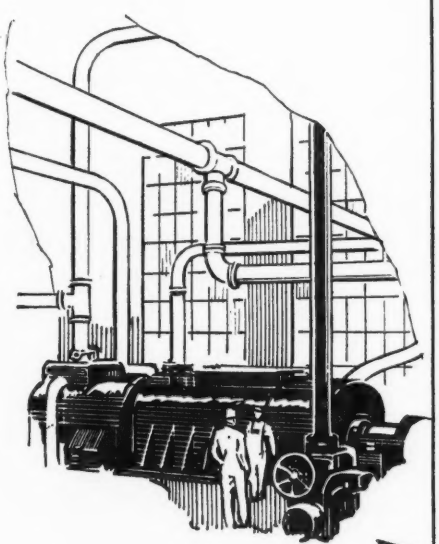
Uniformity of products, fewer rejects and seconds and lower fuel and labor costs are a few of the advantages that automatic temperature control can bring to many plants where these elements are a real issue.



The Fulton Sylphon Company with long experience in solving the temperature control problems of industry will be glad to send an engineer to make a survey of the possibilities for temperature control in your plant. His services are free. Write for Bulletin XS-125.

FULTON SYLPHON Co.
KNOXVILLE, TENN., U.S.A.

FOR EVERY PIPING NEED



WHATEVER your particular piping problem may be, Navco Engineers can help you solve it. With a quarter century's background in every branch of industry, their experience has been wide and varied. This is especially so with regard to the design of piping materials and equipment to withstand high temperatures and pressures.

Navco shops are the most modern in use today. They insure fabricated piping materials that are surprisingly free from maintenance charges.

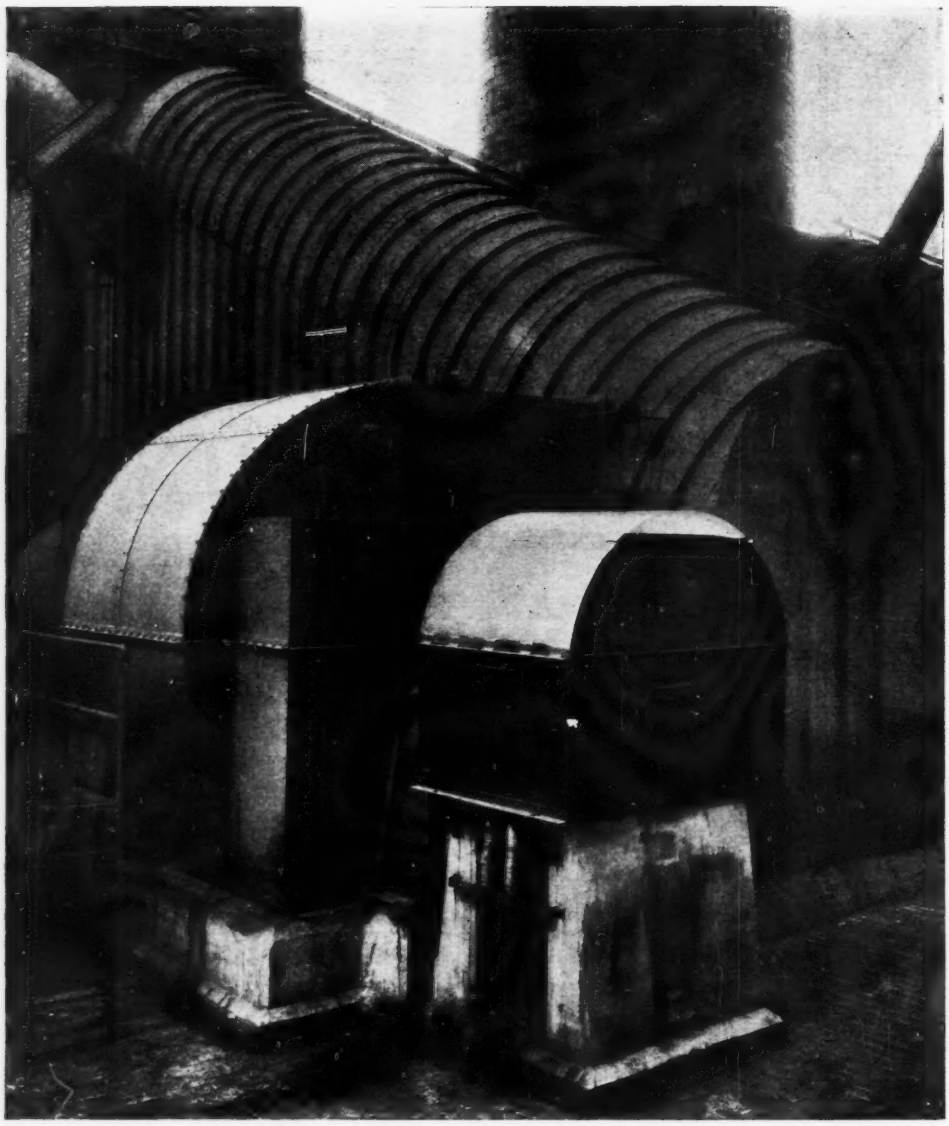
Navco service is three-fold—it includes engineering, fabrication, and erection.

Whether you require just a few pipe bends or a completely installed power and industrial piping system, Navco service will insure the efficient execution of your plans.

NAVCO
PIPING SERVICE
ENGINEERING ••• FABRICATION
INSTALLATION

NATIONAL VALVE & MFG. COMPANY
PITTSBURGH, PA.

Atlanta	Columbus	New York
Cleveland	Chicago	Philadelphia



Wide Experience

WHEN your problem is mechanical draft, you can do no better than consult with Clarage engineers.

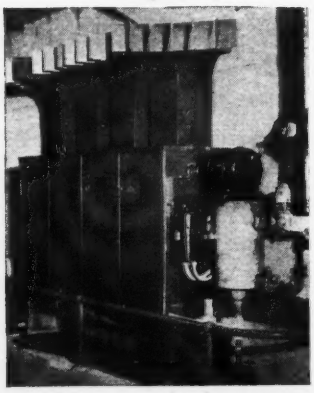
Back of a Clarage recommendation is wide experience gained through almost a quarter century of specialization in this field, plus a complete line of dependable equipment which is modern and highly efficient.

Regardless of what your operating conditions may be — whether your job is large or small — we are in position to successfully meet your requirements. Shown above is one of four Clarage Induced Draft Fans installed in 1929 at Cahokia Station of the Union Electric Light & Power Co., St. Louis. Write us for any information desired. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE

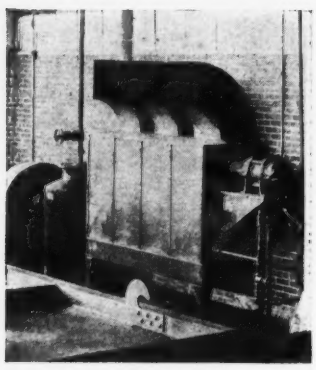
MECHANICAL DRAFT EQUIPMENT

CLARAGE ALSO BUILDS ↓



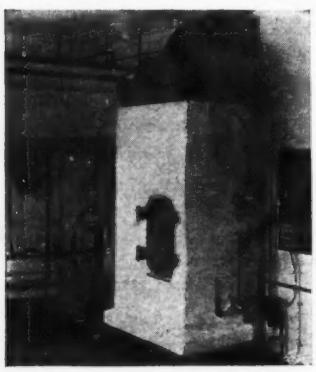
UNITHERM UNIT COOLER

Cooling and refrigeration with utmost economy. Cold air discharged at high velocity by centrifugal fans. Any desired temperature easily maintained, using brine or direct expansion refrigerant. Unit requires but minimum piping and connections, saving labor, materials, and eliminating costly wall coils or bunkers. Very satisfactory, low cost installation. Ideal for any product cooling job, space cooling, etc.



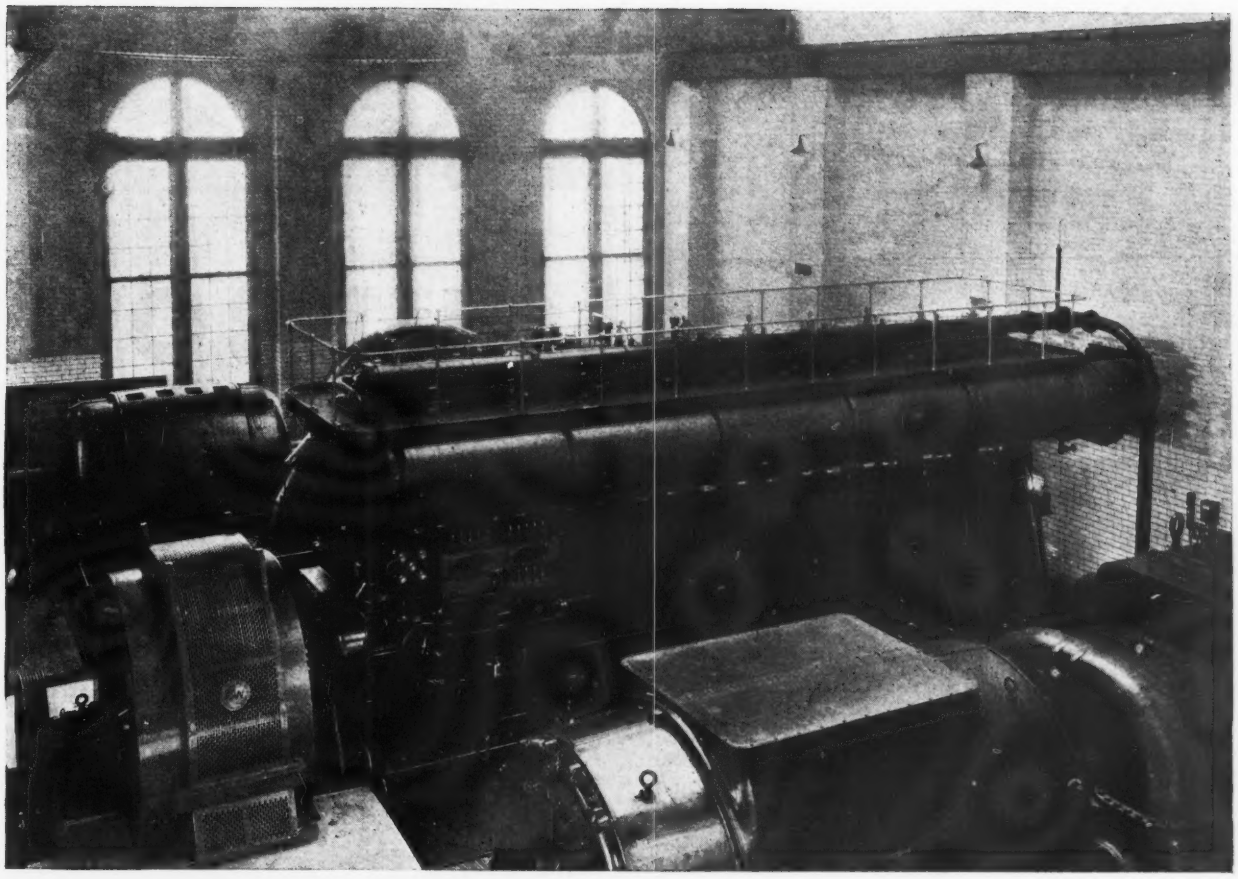
UNITHERM UNIT HEATER

Effective heating over wide areas. Heat where you want it and when you want it. Designed for high or low pressure steam, for floor or ceiling installation. Modern equipment to meet every industrial heating need: greater B. t. u. capacity—decided savings in fuel and maintenance costs—priced for 1932 pocketbooks.



UNIT AIR CONDITIONER

Controls moisture content as well as temperature — provides complete air conditioning. Will humidify or dehumidify as required. Eliminates costly duct distribution system, offers greater flexibility, and invariably produces better results at decided saving. Widely used in printing plants, paper, board and textile mills, chemical plants, bakeries, laboratories, tobacco factories, etc.



3,000 H. P. Diesel Unit Installed Between Two Turbines
in 15,000 K.W. Steam Plant, Union Stockyards, Chicago

DIESEL *added to* Turbine Plant

By utilizing Diesel waste heat contributed to boiler feed water the combination of oil engine steam plant and purchased power by the Pau Corporation produces lower cost power than by Diesels alone. Edward E. Ashley, Consulting Engineer, estimates cost of Diesel generated energy at 3.5 mills. Expected Diesel thermal efficiency 70.8%.

Space limitation favored the new type trunk piston design introduced by Busch-Sulzer in 1930, the low head room, reduced length with flywheel-type generator, and small width due to higher speed — 240 r.p.m. — permitting installation in available space in existing power plant. 5,000 kw. Units of this new type simple Diesel are now available.

BUSCH-SULZER

Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, Mo.

New York, 2 Rector St. **San Francisco, Rialto Bldg.**

FOR STEAM
at *Process Pressures

Give us the simple facts about your requirements

For five years—ever since we announced the Webster Series "78" Thermostatic Trap, we have included in our advertising this invitation: *Give us the simple facts about your requirements. If the Webster Series "78" Trap offers the possibility of a saving for you, we will be glad to deliver one on 60 days trial. You are to be the judge of its performance.*

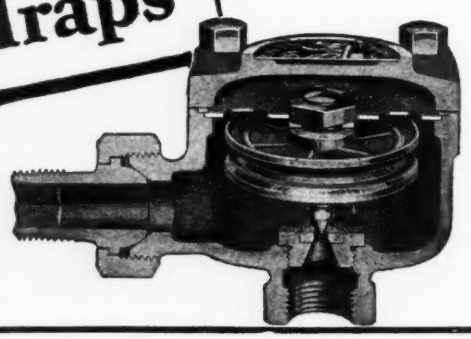
The response to this invitation has been consistently gratifying. Our introduction to many of our best customers on the "78" Trap has been a letter, giving us "the simple facts" . . . And many of our most impressive orders have started with a single "78" Trap ON 60 DAYS TRIAL.

In every detail of design and construction the Webster Series "78" Thermostatic Trap is built for use under the pressures and conditions met with in steam-using process operations. It is built to insure the automatic, continuous and complete discharge of air and water of condensation. Built to stand up under process service.

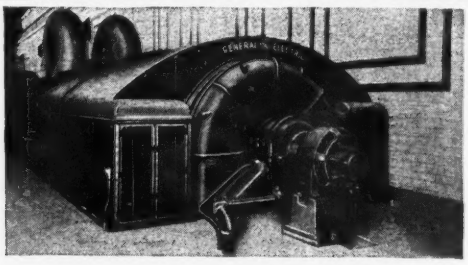
We hope you will accept our invitation — and will "give us the simple facts about your requirements".

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Branches in 60 principal U. S. Cities—Darling Bros., Ltd., Montreal, Canada
a 78-22

Webster "78" Traps



*By "Process Pressures" we mean steam at pressures from 10 to 125 lbs. per sq. in. as used in industrial, chemical and textile manufacture, and in many non-industrial processes, such as sterilizing in hospitals, cooking in hotels, drying in lumber kilns, etc., etc.



TURBOIL
THE PIONEER TURBINE OIL

LUBRICATES THE GIANT TURBINES OF 1932!

TURBOIL accepts the challenge of the modern turbine unit . . equally capable and satisfying in this 160,000 k.w. machine of today, as in the 5,000 k.w. of 1905.

TURBINE LUBRICATION

TURBOIL leads! . . keeps pace with modern trend of turbine size and service . . still unsurpassed in recording quality and endurance.

BORNE SCRYMSER COMPANY
17 BATTERY PLACE, NEW YORK

PIPING HANDBOOK

by J. H. WALKER

Superintendent of Central Heating, The Detroit Edison Company; Member, American Society of Heating and Ventilating Engineers.

and SABIN CROCKER

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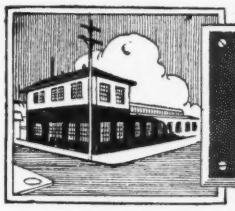

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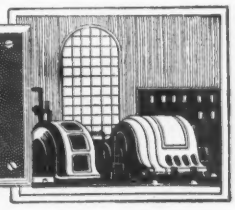

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150	2200–440–220	G.E.	514
150	220–440	G.E.	720
150	220–440–550	G.E.	600
125	220–440	G.E.	1800
100	550	G.E.	720
100	550	Wagner	720
100	550	G.E.	900
100	550	Whse.	900
100	2200	Whse.	900
100	440–220	G.E.	720
100	440–220	G.E.	900
75	440–220	G.E.	600

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240	2200–440–220	G.E.	600
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172	2200–440–220	G.E.	720
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110	2200–550	G.E.	900
100	220–440	G.E.	257

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1—225-kva., 600-r.p.m., 2200-240-480-V., G.E.
1—187-kva., 900-r.p.m., 480-240-V., G.E.
1—187-kva., 720-r.p.m., 480-240-V., G.E.
1—112½-kva., 1200-r.p.m., 2300-240-480-V. G.E.
1—112½-kva., 900-r.p.m., 2200-240-480-V., G.E.
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3—250-kva., Mononey, type HE, 13200-440/220/110-V.
6—200-kva., G.E., type H-KS, 2200-220/440-V.
3—150-kva., Allis-Chalmers, type ODSC 13200-220/440-V.
3—150-kva., G.E., type H, 2200-220/110-V.
3—100-kva., G.E., type H-KS, 2200-220/110-V.
3—75-kva., G.E., type H-KE, 2200-220/110-V.
3—50-kva., G.E., type H-KS, 2200-220/110-V

1—110 hp., **G. E. Syn Motor,** 440 v., 3 ph.
1—400 hp., C. W. **Westinghouse Motor,** complete.
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1—500-kw., 250-V., Westinghouse Synchronous motor Generator Set.
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1—200-kw., 125-V., 3-wire, 3-unit Ridgway.
1—150-kw., 600-r.p.m., 250-V. Gen., 3-ph., 60-cy., 220-440-V. G. E. Synchronous Motor.
1—125-kw., 250-V., Westinghouse Synchronous Generator Motor Set, 3-ph., 60-cy., 230-2200-V.
2—125-kw., 125-V. G. E., 2300-V. motor.
1—100-kw., 125-V., D.C., 220-440 A.C. G. E. Synchronous Motor Generator Set.
1—100-kw., 250-V., Gen., 900-r.p.m., 2200-V., Synchronous Motor.
1—50-kw., 230-V., 1200-r.p.m., 220-V. Westinghouse Synchronous Motor.
2—50-kw., 125-V., 1200-r.p.m., 220-V. Westinghouse Synchronous Motor.

TURBINES

1—475-kva. Westinghouse Non-condensing.

TRANSFORMERS

4—333-kva. Pittsburgh, 4100/110/220-V.
3—200-kva. G. E., 2400/120/240-V.
4—150-kva. Westinghouse, 2400/120/240-V.
3—100-kva. Westinghouse, 2400/120/240-V.

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No.	Kw.	R.p.m.	Volts	Ph.	Type
1	400	900	2300–4000	3	Westg.
1	350	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230–2300	3	G.E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G.E.
1	50	1200	220–440–2300	3	G.E.

MOTORS—3-Phase, 60-Cycle

No.	Hp.	R.p.m.	Volts	Type
1	800	180	4000	Westghse. Syn.
1	600Kva.	900	440	G. E. Syn. Cond.
1	500	150	2300	Elec. Mach. Syn.
1	500	900	440/4000	Westghse. Syn
1	500	900	440–2200	G. E. Syn.
1	350	900	2200/4000	Wh. syn.
2	300	600	445–2300	G. E. syn.
1	250	600	2200/4000	G. E. syn.
1	250	600	220–440	Westg. syn.
1	250	600	440–2200	G. E. syn.
3	200	514	4150–2300	G. E. syn.
2	200	514	2300/4000	G. E. sl. rg.
4	150	1200	220/440	Westg., sl. rg.
1	150	900	2200	G. E. syn.
2	150	514	2200	Westg., sl. rg.
1	150	1800	2200	West. sq. cg. mfr.
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1—1,000-Gal. Goulds Cent. Fire Pump, Fig. 3014, 2-stage, D.C., to 100 H.P. Allis-Chalmers Motor, 3 ph., 60 cy., 2200 v., 1,750 r.p.m. A-1 condition.

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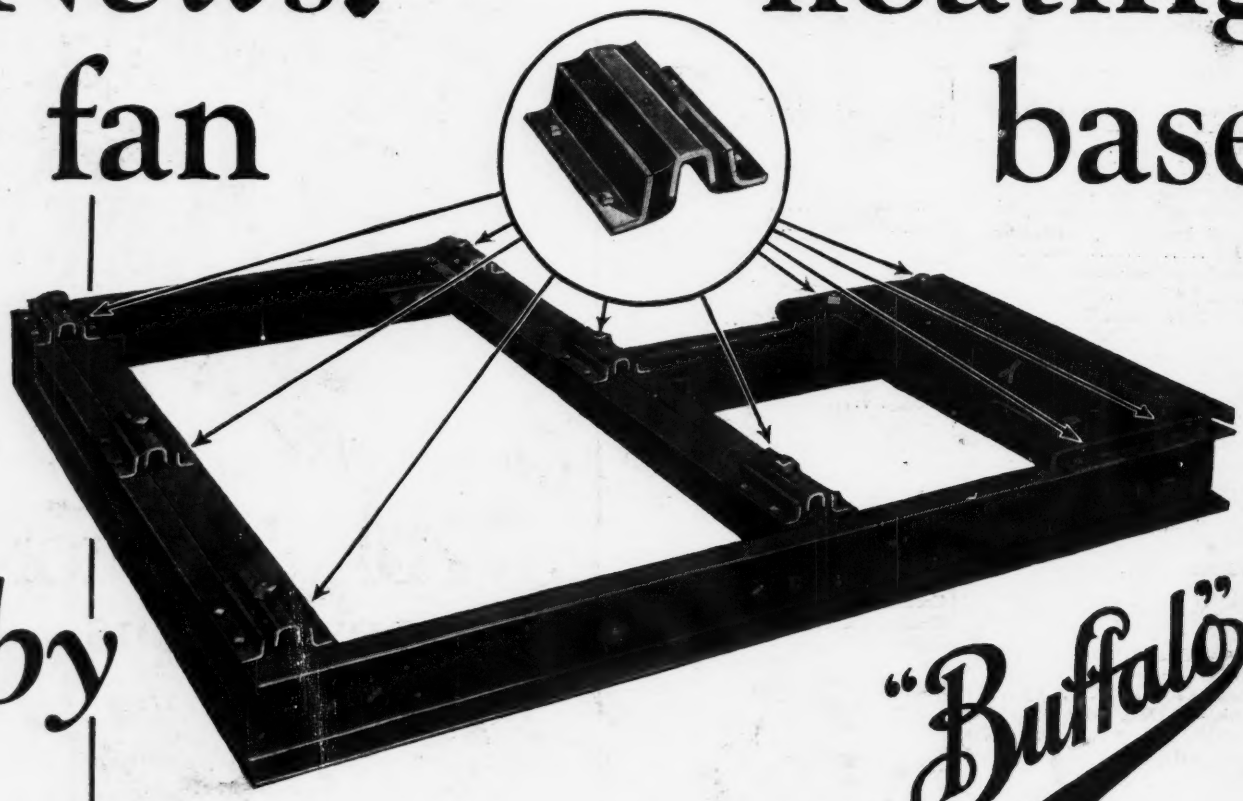

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